TEXAS AGRICUTURAL EXPERIMENT STATION
A, B. CONNER, DIRECTOR
College Station, Texas

FIFTY-FOURTH ANNUAL REPORT
1941

IMPERIAL MYCOLOGICAL
21 NOV 1942
INSTITUTE

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
T. O. WALTON, President

B14-742-4500-L180

TEXAS AGRICULTURAL EXPERIMENT STATION

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April 1, 1942

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Ralph L. Baker, M. S., Turkey Mkt. Spec.
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†L. E. James, M. S., Asst. Poul. Husb
C. W. Carter, M. S., Asst. Poul. Husb.
V. H. Melass, Ph. D., Poul. Husb.

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Carl M. Lyman, Ph. D., Swine Nutr.

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Walter P. Taylor, Ph. D., Chief

Publications:

A. D. Jackson, Chief

---

*In cooperation with U. S. Department of Agriculture.
†On leave.

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————, Asst. Chief
S. D. Pearce, Secretary
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F. R. Brison, M. S., Horticulture
A. L. Darnell, M. A., Dairy Husb.
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V. A. Little, M. S., Entomology
J. C. Miller, Ph. D, An. Husbandry
C. E. Murphy, M. S., An. Husbandry
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R. G. Reeves, Ph. D., Biology
N. G. Schuessler, B. S., An. Husb.
C. N. Shepardson, M. S., Dairy Husb.
P. J. Talley, Ph. D., Biology
Ide P. Trotter, Ph. D., Agronomy

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J. S. Williams, M. A., An. Husb.

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E. W. Lyle, Ph. D., Pl. Path.
*J. B. Pope, M. S., Proj. Leader (S. C. S.)
†*O. C. Word, B. C. E., Agrl. Engr. (S. C. S.)

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*H. M. Beachell, M. S., Asst. Agron. (B. P. I.)

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†P. T. Marion, M. S., Cattle Feeder

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R. G. Evans, B. S., Agron.

No. 9, Balmorhea, Reeves County:

J. J. Bayles, B. S., Supt.

No. 10, College Station, Brazos County:

R. M. Sherwood, M. S., in chg.
L. J. McCall, Farm Supt.

No. 11, Nacogdoches, Nacogdoches Co.:

H. F. Morris, M. S., Supt.

No. 12, Chillicothe, Hardeman Co.:

*J. Roy Quinby, M. S., Supt. (B. P. I.)
*J. C. Stephens, M. S., Assoc. Agron. (B. P. I.)

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I. B. Boughton, D. V. M., Veterinarian
W. T. Hardy, D. V. M., Veterinarian
V. L. Cory, M. S., Range Botanist
O. L. Carpenter, Br. Supervisor

No. 15, Weslaco, Hidalgo County:

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J. F. Wood, B. S., Hort.
G. H. Godfrey, Ph. D., Pl. Path.
P. T. Riherd, M. S., Entom.
W. C. Scott, M. A., Chemist, Ft. and Veg. Products Lab'y. (B. A. C. E.)

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L. E. Brooks, B. S., Supt.
B. S. Pickett, Ph. D., Hort.

No. 17, Ysleta, El Paso County:

S. E. Jones, Ph. D., Superintendent

No. 19, Winter Haven, Dimmit Co.:

E. Mortensen, B. S., Supt.
*L. R. Hawthorn, M. S., Hort. (B. P. I.)
S. S. Ivanoff, Ph. D., Pl. Path.
Wm. H. Ewart, Ph. D., Entom.

No. 20, Stephenville, Erath Co.:

B. C. Langley, M. S., Supt.
T. E. Denman, B. S., Hort.

FIELD LABORATORIES

Apicultural Research, San Antonio:

H. B. Parks, B. S., Apicul. in chg.
A. H. Alex, B. S., Queen Breeder

East Texas Pasture Inv., Lufkin:

E. K. Crouch, B. S., Agron. in chg.

Truck Crop Insect Inv., Alta Loma:

M. J. Janes, Ph. D., Entom. in chg.

Loco Weed Research, Alpine:

*F. P. Mathews, Ph. D., Vet. in chg. (B. A. I.)

Tomato Disease Inv., Jacksonville:

P. A. Young, Ph. D., Pl. Path. in chg.

Tomato Disease Inv., Yoakum:

A. L. Harrison, Ph. D., Pl. Path. in chg.

Sweet Potato Inv., Gilmer:

R. E. Wright, M. S. Hort. in chg.

Fruit Investigations, Montague:

U. A. Randolph, B. S., Hort. in chg.

Cotton Insect Inv., Presidio:

*A. J. Chapman, B. S., Assoc. Entom. in chg. (B. E. P. Q.)

Livestock Feeding Inv., Big Spring:

*F. E. Keating, B. S., Assoc. Agron. in chg. (B. P. I.)

*In cooperation with U. S. Department of Agriculture.
†On leave.

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FIFTY-FOURTH ANNUAL REPORT, 1941

A. B. Conner, Director

The Texas Agricultural Experiment Station, one of the major divisions of the Agricultural and Mechanical College of Texas, is the agricultural research agency of the State of Texas. Its work at the main station at College Station is supplemented by work at outlying substations and field laboratories. Considerable additional work is conducted at other points with cooperating State and Federal agencies.

War, with its many and diverse needs, gives agricultural research perhaps its greatest impetus and serves to bring the results of research into greatest usefulness. The findings of the agricultural experiment stations through many years of research with vitamins, for example, are of particular importance in maintaining the health and well-being of the nation at this time when we must produce sufficient food not only for our own civilian and military needs but also additional food supplies for our allies and for the peoples of certain nations occupied and overrun by the enemy. Research lends encouragement to the production of many products formerly imported but no longer obtainable from foreign countries because of the destruction of war or shortage of shipping. Research, for example, in the development of pure waxy seeded kafirs has provided a source of a particular kind of starch needed for domestic use, huge quantities of which have previously been imported but now unobtainable by importation. The results of research with drug plants have taken on new significance, as for example the work reported in the following pages on devil's shoestring, *Tephrosia virginiana*, as a promising source of rotenone for the control of insects in vegetable crops. Much additional work with drug plants of possible economic value has been stimulated by the necessity of producing in this country supplies to replace those no longer obtainable elsewhere. The control of animal diseases, some of which are communicable to man, the control of plant diseases, the protection of crops against insect damage and depredation, and efficiency and economy in production are increasingly important in times of emergency and the accomplishment of these objectives is possible only by knowledge gained through research. Perhaps there never was a time when agricultural research, and its effect upon production, played such an important part in world affairs as at the present time.

This report of agricultural research is very much condensed and no attempt has been made to cite its application. It gives, however, a perspective of the results of research and some insight into the possible application and use of these results in the conduct of human affairs.

ORGANIZATION AND WORK

The Agricultural Experiment Station System comprises the Main Station with twenty divisions at College Station, seventeen substations in the

several agricultural regions of the State, and ten field laboratories, as follows:

Divisions

Administrative
Agricultural Engineering
Agronomy
Apiculture
Botany
Chemistry
Dairy Husbandry
Entomology
Farm and Ranch Economics
Feed Control Service
Horticulture
Plant Pathology and Physiology
Poultry Husbandry
Publications
Range Animal Husbandry
Rural Home Research
Soil Survey
Swine Husbandry
Veterinary Science
Wildlife Research

Substations

No. 1, Beeville, Bee County
No. 2, Tyler, Smith County
No. 3, Angleton, Brazoria County
No. 4, Beaumont, Jefferson County
No. 5, Temple, Bell County
No. 6, Denton, Denton County
No. 7, Spur, Dickens County
No. 8, Lubbock, Lubbock County
No. 9, Balmorhea, Reeves County
No. 10, College Station, Brazos County
No. 11, Nacogdoches, Nacogdoches County
No. 12, Chillicothe, Hardeman County
No. 14, Sonora, Sutton-Edwards Counties
No. 15, Weslaco, Hidalgo County
No. 16, Iowa Park, Wichita County
No. 19, Winter Haven, Dimmit County
No. 20, Stephenville, Erath County

Field Laboratories

Apiculture Research Laboratory, San Antonio, Bexar County.
Truck Crop Insect Investigation Laboratory, Alta Loma, Galveston County.
Cotton Insect Laboratory, Presidio County.
Loco Weed Laboratory, Alpine, Brewster County.
East Texas Pasture Investigations Laboratory, Lufkin, Angelina County.
Tomato Disease Laboratory, Jacksonville, Cherokee County.
Tomato Disease Laboratory, Yoakum, Lavaca County.
Sweet Potato Laboratory, Gilmer, Upshur County.
Fruit Investigations Laboratory, Montague, Montague County.
Livestock Feeding Investigations Laboratory, Big Spring.

AGRICULTURAL ENGINEERING

Mechanical Harvesting of Cotton

In 1941 the Texas Station cotton harvester was used to test the harvesting qualities of 23 varieties and strains of cotton at College Station and 17 at Lubbock. The average efficiency for all tests was 89.4 per-

cent at College Station and 98.5 percent at Lubbock. At both locations there was a difference of 1¼ grades between hand-picked and machine harvested cotton.

Approximately 3,500 open cotton bolls from the various varieties harvested by machine and from selected plants were pulled with a special scale to obtain data on the pounds pull required to remove bolls from cotton plants of the different varieties. The average pull for the varieties included in the mechanical harvesting tests was 4.69 pounds at College Station and 6.60 pounds at Lubbock.

Data on all bolls pulled from the various varieties showed the average spread of the bur was 119 degrees at College Station and 123 degrees at Lubbock. Data were also obtained for each boll on the length and diameter of the peduncle, the number of tags left in the boll after picking, the interseed fibre drag, and the compactness of the lock. The cotton from all of a selected plant was placed in a small cleaner and tested for its cleaning qualities, and the fibre judged as to harshness, density, and adherence to the seed. Staple length was also obtained.

Smith, Killough, Jones (D. L.), and Byrom.

Efficiency In Distribution and Placement of Cottonseed and Fertilizer

Experiments in this project were conducted this year at the Main Station Farm and at the Brazos River Field Laboratory. A narrow shovel opener one-inch wide gave better stands than did a wide four-inch shovel opener. Three combinations of press wheels were used with a knife or runner opener, and with narrow and wide shovel openers. The results obtained varied with the different openers and with the soil type. Fuzzy cottonseed were planted at low, medium, and heavy rates. The number of plants obtained per hill at the Main Station Farm was 5.5, 8.3 and 10.6, respectively, while at the Brazos River Field Laboratory the number of plants per hill was 3.7, 6.8 and 7.3, respectively. Four tests were planted with a hill drop mechanism then thinned to 1, 2, 3, and 4 plants per hill. All hills were 14 inches apart. One test was planted at a low rate and left unthinned. On the Lufkin soil the highest yield was obtained with the two plants per hill while on Yahola Clay the 4 plants per hill gave the highest yield. Both fuzzy and delinted cottonseed were planted at five different depths, namely, ½, 1, 1½, 2 and 2½ inches. On the Lufkin soil the ½-inch depth of planting emerged earlier and gave the best stands for both the fuzzy and delinted seed. It was difficult to obtain accurate differences of a half-inch in depth on the Yohola Clay soil. The 2½-inch depth gave the best stand for the fuzzy seed, while the ½-inch depth was best for the delinted seed.

Smith and Byrom.

Atmospheric Exposure of Wire and Fencing

(In cooperation with the American Society for Testing Materials)

Some of the light zinc-coated camples show some yellowing and rust-like specks while the heavy zinc-coated samples show only the effects of

weathering by becoming grayish in appearance. The corrosion resistant steels show more rust than last year. Details of the condition of all samples appear in the Annual "Wire Test Report" published by the American Society for Testing Materials, Philadelphia, Pennsylvania.

Smith and Byrom.

Garlic Drying.

The methods of drying and curing garlic to prevent decay during 1941 were :

(1) hot air in a drier for 29½ hours at an average temperature of 122° F. for the ingoing air and 114° F. for the outgoing air,
(2) on wire shelves under a galvanized sheet iron roof for 12 days,
(3) piled on ground and left exposd in the field for 12 days,
(4) spread on wire shelves in barn loft for 12 days,
(5) spread on floor of barn loft,

There was less shrinkage and decay during storage when garlic was placed on wire shelves either in the field shed or in the barn. Garlic left exposed in the field gave higher percentages of shrinkage and decay than either of the other treatments. Garlic piled 3 to 4 bulbs deep on the floor of the barn sweated and became so damp that it had to be removed and sun dried for several hours before it could be cleaned. The sweating also caused the bulbs to have an objectionable brownish color.

The effect of various chemical treatments is reported by the Division of Plant Pathology and Physiology. Smith, Byrom and Altstatt.

AGRONOMY

Fertilizers for Field Crops.

This experiment is conducted with cotton, corn, and oats at the Main Station, College Station, and with cotton and corn at Substation No. 3, Angleton. The test at Angleton in 1941 was destroyed by the tropical hurricane on September 23.

Cotton. At College Station in 1941 the unfertilized soil produced 143 pounds of lint cotton per acre as compared with 276 pounds for the soil that received 400 pounds of a 6-12-4 fertilizer. The results for the 15 years show clearly that the soil, Lufkin fine sandy loam, responds to applications of nitrogen, phosphoric acid, and potash and that a 4-12-4 fertilizer at the rate of 400 pounds per acre has given good results.

Oats. At College Station the treatment of 800 pounds per acre of a 4-12-4 fertilizer made the highest yield of oats, 71.5 bushels per acre as compared with 25.2 bushels for the unfertilized oats. This difference in yield seems to be due largely to the fact that rust-resistant oats, which have just been developed by the station and grown in the test for the first time, allowed them to use the fertility added in the fertilizer unhampered by the rust. In previous years no such differences in yield

were observed. For the 15 years of the test the 800 pounds of 4-12-4 fertilizer also produced the highest average yield, 37.4 bushels per acre, and the unfertilized oats 24.2 bushels. Reynolds and Stansel.

Legumes for Soil Improvement

The work with winter legumes for soil improvement is conducted at the Main Station, College Station, and at the substation at Tyler, Angleton, and Nacogdoches. In 1941 the experiment at Angleton was destroyed by a tropical storm on September 23 and the test at Nacogdoches was practically ruined by anthracnose.

At College Station in 1941 the treatment of vetch and 4-8-4 fertilizer made the largest yield, 420 pounds of lint cotton per acre, which was more than double the yield of 199 pounds from the untreated soil. During the five years of the test 1937-41, however, the average yield of this treatment and of the treatments of vetch and 0-8-4 fertilizer and 4-8-4 fertilizer were practically the same, 307, 301, and 296 pounds of lint per acre, respectively. The results show that the soil needs both nitrogen and phosphate and that phosphate is needed before nitrogen.

In the experiment at Tyler, where cotton and corn are grown in a two-year rotation, cotton was a practical failure in 1941 as a result of too much rain. The corn, however, produced about normal yields. The untreated soil produced 11.5 bushels per acre. Corn that received residual effect of vetch, without any other treatment, yielded 26.4 bushels per acre; where 100 pounds of sulphate of ammonia was applied on the vetch land, corn produced 29.9 bushels per acre.

Reynolds, Johnson, Stansel and Morris.

Genetics of Qualitative Characters in American Upland Cotton

Five trisomic plants were crossed with plants homozygous for the simple genetic characters green lint, virescent yellow leaf, round leaf, boll apical furrow, cluster fruiting, lintless seed, and with synthetic line No. 7 combining the simple characters okra leaf, petal spot, brown lint, smooth seeds, and red leaf, to determine the inheritance and linkage relations. F_1 plants from crosses of the five trisomics with synthetic line No. 7 were grown in the greenhouse and backcrossed to plants homozygous recessive for the genetic character under investigation.

Killough.

Cotton Variety Tests

In the Gulf Coast Prairie and sections where cotton is grown under irrigation, Deltapine 14 (44-51), Rogers Acala No. 111, Stoneville 2B and 5A, Washington (Delfos 719), Coker 100 strain 5, Ambassador, and Acala 2815 (37A) continued to be the most profitable varieties.

In eastern and central Texas, Watson, Bryant Mebane, Roldo Rowden, Hi-Bred, Deltapine 14 (44-51), Ferguson 406, Cliett, and New Boykin produced the highest yields.

Western Mebane 140, Western Prolific, Lockett 140, Hi-Bred, Deltapine 14 (44-51), Northern Star, Ferguson 406, Stoneville 2B, and Rogers Acala were the better varieties in the western part of the state.

Killough.

Improvement of the Peanut

The work on this project was inactive during the year except for maintaining a small supply of seed of the Macspan peanut at the Main Station.

Roberts.

Rice Improvement and Production Tests

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

The work under this project is conducted at Substation No. 4, Beaumont. The work includes (a) breeding and selections; (b) testing of commercial varieties and new strains and varieties developed in the breeding work; (c) experiments on time, method, and rate of application of fertilizers; and (d) studies on irrigation. The results obtained in 1941 will be found in the report of Substation No. 4. Wyche and Beachell.

Breeding Small Grains For Resistance to Rust

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

The breeding of rust resistant varieties of wheat, oats, and barley has reached the stage where one or more varieties of each of these crops have either been released for commercial growing or are being increased for release in the near future.

Two varieties of oats, named Ranger and Rustler, that are highly resistant to crown rust and sufficiently early maturing to usually escape stem rust injury were released to commercial growers in South Texas in the fall of 1941. Other varieties that are resistant to both rusts are being increased for future release.

Three varieties of wheat that are resistant to both stem rust and leaf rust are being increased for release to commercial growers; one for the central blacklands, one for the southern blacklands, and one for the Lower Rio Grande Valley.

A giant beardless variety of barley that makes an exceptionally vigorous growth during the winter months and is moderately resistant to leaf rust has been released for growing as a winter forage crop in the Lower Rio Grande Valley. Another variety of barley that is highly resistant to leaf rust and a good grain producer is being increased for release in the southern blacklands.

McFadden and McDowell.

Inheritance and Improvement in Corn

Results from extensive tests conducted at several of the substations this year showed that the best of the newly developed Texas hybrids gave average increases in yield of at least 20 percent over the standard commercial varieties. Likewise, these Texas hybrids outyielded the best of the out-of-state hybrids included in the test. Approximately 8,000 bushels of Certified Texas hybrid seed corn were produced in 1941, and to provide for further production in 1942 about 6,000 pounds of single cross seed were produced by the Experiment Station this year. A sweet corn hybrid test was conducted at College Station, Weslaco, and Denton, and a few of the better hybrids were selected for further testing.

Rogers and McDowell.

The Genetic and Cytological Relationship of Zea, Tripsacum, and Euchlaena

(In cooperation with the School of Arts and Sciences, A. & M. College of Texas)

In further work between number of chromosome knobs of maize and proximity of the races of Guatemala, the smallest numbers of knobs were found in races from Eucador, Peru, and Bolivia, all of which averaged less than 0.5, and the greatest numbers from Guatemala, which averaged 92.5. The numbers from all other countries were intermediate. The relationship between number of knobs and proximity to Guatemala approaches linearity.

Teosinte has a greater average number of knobs than any varieties of maize. It is most abundant in Guatemala, and hybridizes naturally with maize. The chromosome knobs of maize probably have been acquired from teosinte by hybridization, and the new types of maize resulting from this hybridization seem to have spread more or less concentrically to other regions.

Reeves.

Breeding Cotton for Mechanical Harvesting

In the breeding work to combine in synthetic types those characteristics found to be best suited to mechanical harvesting, the coarser-bodied, medium-staple varieties such as Gorham's Lone Star, Western Mebane 140, Western Early, and Mebane 804-50 were used as parents. In cleaning mechanically-harvested varieties and hybrid strains prior to ginning, it was found that the coarser-bodied, medium-staple types with compact locks and fibers dense on the seed graded from one to three commercial grades higher than the softer-finer-bodied, longer-staple types, representing an increase in value of three to ten dollars a bale. In order to further increase the yield of the present hybrid strains, these have been crossed with two new high yielding varieties, Deltapine 14 (44-51) and Half and Half Selection 25.

Four of the hybrid strains, Gorham's Lone Star X Deltapine 112, Mebane 140 X Ducona 30-31, Western Early X Ducona 17 strain 1, and Western Early X Ducona 17 strain 10, made yields 11, 12, 15, and 24 percent higher, respectively, than the average yield of the selected high yielding commercial varieties used as standards, or checks.

Killough, Smith, Jones (D. L.) and Byrom.

Effect of Fertilizers on Yield, Chemical Composition and Botanical Composition of Pasture Herbage

(In cooperation with the Tennessee Valley Authority)

This project is conducted at Angleton, Beaumont, Tyler, Stephenville, and Falfurrias, Texas.

The results obtained indicate that phosphate is needed for pastures on the soils at these places. The application of 40 to 80 pounds of phosphoric acid in TVA superphosphate has greatly increased the yield of clovers seeded in the pastures or has enabled the clovers to come in naturally without seeding. For example, at Angleton application of superphosphate has produced a luxuriant growth of white clover, while there is practically none on the plats that have not received superphosphate. At Beaumont superphosphate alone almost doubled the yield of pasture forage. A combination of superphosphate and 100 or 200 pounds of sulphate of ammonia (which furnishes 20 or 40 pounds of nitrogen) has produced larger yields than superphosphate alone. Potash has produced some increases in yield but has not been as effective as nitrogen or phosphate. Lime has increased the yield of pasture forage about 20 percent at Beaumont. At Stephenville nitrogen was more effective than either phosphate or potash in increasing the yield of buffalo grass.

On the King Ranch, near Falfurrias, superphosphate containing 47.3 percent available phosphoric acid was applied at the rates of 100, 200, 400, and 800 pounds per acre, and calcium and potassium metaphosphate at a rate to supply the same amount of available phosphoric acid as 200 pounds of superphosphate. The soil is Nueces fine sand, which is the main soil in that area. The phosphate increased the yield of pasture forage 32 to 54 percent. Potassium metaphosphate increased the yield 55 percent and calcium metaphosphate 32 percent. This fact indicates that the soil also responds to potash or that the phosphoric acid in potassium metaphosphate is more readily available than that in calcium metaphosphate.

The application of 200 pounds or more of superphosphate greatly increased the phosphoric acid content of the grasses and in all cases throughout the grazing season to a point where the phosphoric acid was not deficient for animal nutrition. In one species of grass, *Brachiaria ciliatissima*, the superphosphate increased the percentage of phosphoric acid seven fold, from 0.11 percent to 0.77 percent.

Reynolds, Hensel, Fraps, and Jones (J. H.).

Improvement or Range and Pasture Plants

Buffalo grass crosses made in 1940 were planted in nursery plats during the year and their behavior noted. Further studies of 38 Rhodes grass plants were made and seed were sent to San Antonio and Beeville for increase plantings to be made for large scale plantings under field conditions. General observational row plantings of grasses, both native and introduced, which have been made during the past 5 years were concluded and only those which show definite promise have been retained for further intensive study. Live material and seed of grasses which may be adapted to their respective localities were sent to Beeville, Angleton, Denton, Temple, and Stephenville.

Seed of what was supposed to be a cross between *Andropogon annulatus* and *A. ischaemum* were planted in the nursery and carefully observed. All of the plants so closely resembled *A. ischaemumu* and had none of the characters of *A. annulatus* that it was concluded that they were not hybrids. *Phalaris tuberosa*, and *Festuca elatior* var. *arundinacea* growing here and at Denton and Temple have lived through two summers and show great promise. *Chloris petrea*, *Andropogon ischaemum*, *Paspalum malacophyllum*, and Paraguay strains of Bahia grass sent to the Beeville station showed up very favorably. Five annual and 16 biennial strains of sweet clover and 9 strains of alfalfa planted at the Barnhart station grew well, bloomed, and reseeded themselves. Tall, or alta, fescue broadcast on more favorable sites on some of the pastures at the Texas Range Station in September had grown to a height of three to five inches by December. Hensel and Brittingham.

Limiting Factors in Pasture Production

Vegetative chartings made at Beaumont again show that the addition of phosphate to the plats increased the amount of trifolium clovers and Dallis grass. The actual percentage of the clovers was considerably less than in 1940. This is due to the abnormally high rainfall which flooded and caused water to drown a greater portion of the plants. Yield data on the King Ranch where rainfall was also abnormally high showed that the application of superphosphate increased total yield of range forage as high as 55% depending on the amount used. Chemical analyses of forage showed that the application of superphosphate in amounts as low as 100 pounds per acre increased the amount of P_2O_5 to a point where the vegetation was no longer deficient in phosphorus. Alyce clover on the King Ranch showed a remarkable response to phosphate fertilizer. Plants on untreated plats grew to a height of 6 inches while on fertilized plats they grew to 30 inches or more Hensel and Brittingham.

Management of Grazing Lands

At the Texas Range Station vegetative chartings to note different systems of management in controlling poison bitterweed were made, thereby

completing four years of such work. The data on the occurrence of bitterweed, buffalo grass, curly mesquite, and tobosa grass for this period were analyzed statistically with regard to systems of management, rainfall, and temperature.

It has not been possible, during the four-year period, to detect any significant effect of management on botanical composition. There is, however, a considerable seasonal effect of rainfall and temperature on the prevalence and persistence of both poison bitterweed and the perennial grasses. Vegetation during 1941 was particularly luxuriant due to the more than normal rainfall which extended throughout the year.

Hensel and Brittingham.

Wheat Breeding and Wheat Production in the Panhandle-Plains Region

(In cooperation with the Soil Conservation Service)

In a test of 14 varieties and strains of wheat at Amarillo and on cooperative farms, the yields of commercially important varieties over a period of years are as follows: Tenmarq 14.6 bushels per acre, Blackhull 13.7, Kanred 14.1, Certified Turkey 12.9, Early Blackhull 12.5, Cheyenne, 14.0, and Chiefkan 15.3. On the basis of quality tests, as well as yields and other agronomic characteristics, Tenmarq, Turkey, and Blackhull are recommended for the High Plains. Comparable yields of some of the outstanding new strains are: Comanche 16.1, Pawnee 17.2, and Kawvale X Tenmarq (35-34-117) 24.0.

In breeding work with 97 varieties and strains, three strains, Kanred-Hard Federation X Tenmarq, selections 33-34-303 and 25-34-116, and Early Blackhull X Tenmarq, T. S. No. 26984, appear to have possibilities as commercial varieties from the standpoint of quality, yield, test weight, and other characters.

Tests are being conducted in cooperation with the Soil Conservation Service to determine the effect of different types of tillage preparation for wheat with relation to wind erosion, but data are as yet inadequate to make definite recommendations. Results obtained with strip cropping of sorghum as protection to adjacent wheat strips indicate that a sorghum strip 126 to 189 feet wide is necessary for adequate protection of wheat strips up to 320 feet in width.

Reid (David A.).

Cytogenetics and Improvement of Cotton

In 1941 six species hybrids were produced in addition to the ones already available at this Station. From some of these sterile hybrids and hybrids produced earlier, seven additional polyploids were produced, three of which are considered new species.

Seven polyploids produced from American upland and wild species on Asiatic cultivated cottons have been backcrossed one to three times in

attempts to transfer genes of economic value to American upland cottons. Some of these progenies showed no infection of angular leaf spot. A few plants from the second backcross of a hybrid involving the wild cotton from Southwestern United States and American upland cotton had fibers with a strength index equal to that of fibers of Sea Island cotton.

From the backcross work in which hexaploids were backcrossed to American upland, which is tetraploid, one or more generations can be eliminated by using the first backcross, a pentaploid, as the pollen parent.

In a population grown from seeds produced by pollinating normal flowers of Rogers Acala with X-rayed pollen, one haploid was found. If this haploid was the result of X-raying pollen the frequency of the haploids is too low to be of commercial value. The chromosome number has been doubled in haploid of three upland varieties, Acala, Stoneville, and Mexican, to produce pure lines. Beasley and Richmond.

Adaptation and Improvement of Legumes

Progress was made in the effort to develop a leafier, finer-stemmed annual sweetclover more suitable than Hubam for hay and grazing. In the biennial sweetclovers, the type and extent of segregation in the progeny of *Melilotus alba X M. suaveolens* hybrids grown at Denton indicated that leafier, finer-stemmed strains may be developed for North Texas.

Various species and strains of vetch were grown and marked differences in forage and seed production were noted.

Spring-planted soybean strains and varieties differed in seed production according to locality and climatic conditions. They were most promising at Beeville and Weslaco. At Weslaco fall-planted soybeans varied in yield from 5 to 45 bushels per acre. The seed ripened in 80 to 90 days after planting, was of exceptionally high quality, and showed little tendency to shatter. Manke and Reynolds.

Development of New Varieties of Cotton by Varietal and Species Hybridization

From several varietal crosses, over 3000 F_2 plants were grown and about four flowers were self-pollinated on each. Some of the plants were eliminated by field selection. The others were harvested and have been analyzed in the laboratory. Beasley, Richmond, and Killough.

Land Use Adjustment in the West Cross Timbers

This cooperative project between the Division of Agronomy and Division of Farm and Ranch Economics is conducted at Substation No. 20, Stephenville. The results obtained in 1941 are given in the report of that station. Langley and Bonnen.

Varieties of Small Grain and Rye Grass for Winter Pasture

(In cooperation with School of Agriculture, A. & M. College of Texas)

The results with 22 varieties of oats for two years show that there is a great difference in the ability of different varieties to produce green forage at the time when green forage is most valuable for livestock pasturage on Texas farms. The highest-yielding varieties have produced from 7 to 10 tons of green matter per acre and the yields of low-yielding varieties have ranged from complete failure, due to freezing out, to 4.5 tons of green matter.

In severe winters only the true winter-type of oats produced consistent and satisfactory yields. In normal winters the intermediate types have yielded much more pasturage. Nortex X Victoria M 19-17 (Ranger) was the outstanding yielder in 1940-41, giving 19,995 pounds of green matter per acre in eleven cuttings. However, other selections from the same cross ranked lowest in production during the winter months of December and January. Trotter.

Growth Substances in the Treatment of Cotton seed

Extensive use was made of growth substances, especially indolebutyric acid, in treating cotton seed prior to planting. Special attention was given to the effect of seed treatment on abundance of lateral roots produced by cotton seedlings. Counts were made of the number of lateral roots produced along the first inch of the tap root of 10-day-old seedlings grown throughout all seasons of the year under greenhouse conditions. Records were also obtained on emergence but stands were not materially reduced except by a few semi-lethal dosages of the growth substance.

Seedlings from untreated fuzzy Watson seed produced an average of 15, 17, 15, and 15 lateral roots per inch during the spring, summer, fall, and winter months, respectively. Seedlings from Watson seed soaked 24 hours in an aqueous solution of 250 parts per million indolebutyric acid prior to planting, produced 21, 24, 15, and 7 percent more lateral roots than those from untreated seed during the spring, summer, fall, and winter respectively. Corresponding percentages for seed soaked in 500 parts per million indolebutyric acid solution were 42, 53, 23, and 5. Rea.

Flax As a Winter Crop In South Texas

(In cooperation with the Bureau of Plant Industry,
U. S. Department of Agriculture)

Experiments in the production of flax as a winter crop for South Texas have resulted in the isolation of varieties that are resistant to rust and more winter hardy than the standard Bison and Punjab varieties. One of these varieties, named Rio, which was released by the Texas Experiment Station in the fall of 1939, successfully withstood a severe rust

epidemic that ravaged the fields of Bison and Punjab in 1941. As a result, the Bison and Punjab varieties were almost completely replaced by Rio in commercial seedlings made in the fall of 1941. Other varieties that are resistant to rust and more winter-hardy than Rio are now being increased. These varieties should make it possible to produce flax from fall seeding much farther north than is now possible.

McFadden and McDowell.

Inheritance and Improvement in Sorghum

Scarcity of labor due to war conditions and high costs of harvesting the old standard varieties of grain sorghums have brought about an imperative demand for dwarf varieties suitable for combine harvesting. Breeding work having this objective has been under way for several years during which time a great many strains of this type have been developed through hybridization and tested. This year two of the best hybrid strains, the parents of which were kafir and milo, have been increased, given variety names, and are being distributed to farmers and to certified seed growers. Selection No. 7000-3 has been given the name of Caprock and No. 7005 has been named Plainsman. Both of these combine types grow about three feet tall, have stout, juicy stalks, with 14 to 16 leaves and resemble kafir plants. Heads are long and cylindrical like kafir. The seed are reddish in color. Both varieties are resistant to Pythium root rot and withstand chinch bug infestations much better than milo. Caprock is slightly taller, averages about two leaves more per stalk, is four to five days later in maturity, and has averaged 1.9 bushels more grain to the acre than Plainsman during the past two years. In 1941 Caprock yielded 44.8 bushels, Plainsman 40.3, and Texas Dwarf Yellow milo 31.7 bushels to the acre.

Bonita, a new hybrid of feterita, kafir, and hegari parentage which looks like a double dwarf, early, Hegari, was increased for distribution in 1942. It yields well, has a pithy stem like Feterita, and has compact heads and white seeds that resemble Hegari. Bonita will be distributed as a variety to combine in parts of Northwest Texas where the use of milo and feterita is being abandoned on account of chinch bugs.

Other breeding work with the objects of producing a chinch bug resistant milo, a yellow kafir, a sweet-stalked kafir, a sweet-stalked milo, and a double dwarf yellow Hegari is approaching a point where such new strains can soon be increased for distribution.

The importation of Cassava starch from the East Indies has been greatly curtailed as a result of the war and there is a likelihood of a real demand in this country for the type of starch that makes up waxy grains in Sorghums. A variety of Blackhul kafir with "waxy" endosperm has been developed and increased, and is ready for distribution if laboratory tests now under way show this type of starch is needed for special industrial purposes.

A number of sorgo strains of low tannin content that have White African as one parent and either Orange or Sumac as the other are being distributed for tests in several areas of the State.

Milo root rot (Pythium arrhenomanes) was widely prevalent and destructive in sorghums this season. Seed of a new resistant strain, Sooner Milo No. 8, was increased for general planting this year for the first time. It yielded 26.09 bushels to the acre, compared with 13.51 bushels produced by the susceptible parent strain. Indicative of the increased yields obtained from the new resistant strains, Texas Milo, resistant, produced 35.6 bushels while the old parental variety Dwarf Milo, produced 18.6 bushels to the acre. Darso No. 28 yielded 38 bushels compared with 3.9 bushels for the old Darso, or almost ten times as much as the susceptible Darso parent.

Selection for resistance to Charcoal rot (Sclerotium bataticola) is being continued. This disease was present again this year but the moisture supply was adequate throughout the season and damage to the sorghums was not nearly so severe as in the previous year.

Sudan grass breeding work having as its objective a new strain with the valuable characteristics of ordinary Sudan grass and in addition sweetness and juiciness of stem, non-shattering seed habit, resistance to foliage diseases, and distinctive glume color has been under way for several years and is now nearing completion. The desirable characteristics have been incorporated into Sudan grass by crossing it with Leoti sorgo, and back-crossing desirable plants to Sudan grass. A number of new strains are satisfactory now from the standpoint of all the desired characters with the possible exception of resistance to foliage diseases, but even in this respect the new strains are better than ordinary Sudan grass. Several of the best strains will be planted in isolated plats in 1942 and the plats will be carefully rogued for increase seed of the best strain for an initial distribution to growers.

During the past three years a study has been made of the inheritance of genes that affect maturity in sorghum. Because of the important part they play in varietal adaptation these genes are being called adaptation genes. Lateness is dominant to earliness in one gene but the reverse is true in other cases. Milo and Sooner milo differ by a single adaptation gene that is expressed as a difference in maturity under normal length of day. The Milo maturity is a simple dominant to the Sooner milo maturity when an F_2 generation is grown in the fields.

Under a ten-hour day the two varieties are similar in maturity. There is no segregation of maturity date when an F_2 generation of a hybrid between them is subjected to a ten-hour day. The conclusion is that the two varieties differ by a gene that brings about a difference in response to length of day. When each of the varieties, milo and sooner milo, is crossed to Blackhul kafir, there is marked hybrid vigor in the F_1 but the hybrid vigor is more than twice as great in one instance as in the

other. The difference between the F_1 plants of the two crosses is only a single gene. Since a single gene has such a profound effect it appears likely that a few genes that act in a similar manner could account for hybrid vigor in sorghum.

Sorghum varieties have been subjected to ten-hour days and in most cases the short-day treatment resulted in a shortening of the growing period. The one notable exception was Acme broomcorn that grew identically in both length-of-day environments. Hegari and Milo flower quickly under short-days and the other varieties used fell between Hegari and Acme broomcorn in time of flowering. These results seem to indicate that the gene that brings about response to length of day is one of the important adaptation genes but that there are others that also play an important part.

Male sterility in sorghum was observed independently at Chillicothe in Texas blackhul kafir and at the Millets Breeding Station, Coimbatore, India, in a durra variety in 1935. Both male steriles were reported as single factor recessive characters and the factor pair for each was designated *Msms*. It now appears that these characters are controlled by different genes and factor pairs for the durramale sterile are being called Ms_1 ms_1 and for the kafir male sterile Ms_2 ms_2. In the cross Ms_1 Ms_1; ms_2 ms_2 (Texas) x Ms_1 ms_1: Ms_2 Ms_2 (Coimbatore), 28 F_1 plants in the field under normal day bloomed and produced normal anthers and pollen but did not mature; 15 F_1 plants grown in the greenhouse produced normal anthers and matured seed on bagged heads; the 15 F_2's grown into the F_2 under mum-cloth shades all segregated for male sterility, 7 populations in a 9:7 ratio and 8 populations in a 3:1 ratio.

A liguleless leaf character in sorghum was found to be inherited as a simple recessive. The leaves lack both ligule and auricles and stand upright at the base. A linkage between liguleless and tight or compact panicle with a cross-over of 8.5 percent and the inheritance of this character independently of glume color and of undercoat was recorded.

Karper, Quinby, Stephens and Jones (D. L.).

APICULTURE

The Apicultural Research Laboratory is located near San Antonio with a yard near Dilley and an outyard in cooperation at Roxton.

Activities of Bees

This study of the reaction of bees to the weather and to honey plants was planned to obtain information as to the division of the weather or combination of divisions of weather which control all life activities of the honeybee. In the year 1941 the weather was such as to produce a condition which was optimum for the bee activities but was not optimum for the secretion of nectar of certain honey producing plants. The comparison of these data with those of former years indicates that high honey

production occurs only in years where there are at least thirty days in spring during which the temperature is above a mean of fifty-seven degrees F. and below a maximum of ninety-four degrees F. A comparison of the number of such days during the total number of years of this experiment with the surplus honey deposited indicates that rainfall during the previous year also is a factor. The year 1941 as measured by the fifty-seven-ninety-four degree period should have been the highest in honey production during this study, but was not, due to the absence of certain nectar producing annual plants. These were not present due to insufficient moistures during the winter of 1940. Parks.

Adaptability of Native Plants

The study made here of adaptability of native plants originally was confined to the growing of plants on this Station which were suspected of being useful either as ornamentals or for bee pasturage. The widespread interest in native plants brought such a demand for information to the Laboratory that material was collected from every possible source principally from observations made throughout much of the State of Texas. During the present year a study was made of the plants in the Lower Rio Grande Valley especially those suspected of being useful in covering blowing sand areas. The plants studied consisted of those species growing in the neighborhood where it was ascertained that they had invaded and controlled blowing sand. Lists of these plants were made. The information mostly sought relative to plants comes from research institutions. During the year information relative to occurrence and and in many cases herbarium sheets or small samples were supplied. Information, samples, or herbarium sheets of the following plants were supplied during the year; (1) fiber plants: Ramie, *Boehmeria nivea* (L.) Gaud.; Chisos Bear Grass, *Nolina erumpens* (Torr.) S. Wats.; *Agaves* and *Yuccas;* (2) wax plants: Candelilla, *Euphorbia antisyphilitica* Zucc.; mesquite. *Prosopis chilensis* (Molina) Stuntz; wild cherry, *pruns eximia* Small; (3) rubber plants: Guayule, *Parthenium argentatum* A. Gray; mariola, *Parthenium incanun* H.B.K. goldenrod, *Solidago* sps.; (4) oil producing plants: Perilla, *Perilla frutescens* (L.) Britton; castor beans, *Ricinus communis* L.; Tung oil, *Aleurites fordi;* sage, *Salvia reflexa* Hornem.; (5) drug plants: horsemint, *Monarda* sps.; Agave; Yucca; dogwood, *Cornus florida* L. In many of these cases the information and plants wanted were at hand at the Laboratory, however, in one instance of drug plants it was necessary to make a trip entirely across the State of Texas to obtain the samples needed. A sample of from twenty-five to three hundred pounds was taken of each species of Yucca and Agave known to occur in the State. Of smaller requests for plants which were supplied were: lichens to be tested for insecticides; Solanum fruits and Helenium species were sent for analyses for chemical content; and small lots of plants suspected to contain dye material. Each recipient of material either has or will supply a report on the results of work done with the plants they obtained. The plants growing here at the

Laboratory definitely under this heading were so depleted during the past drought years that it has required the entire year to bring them back to the normal condition. Parks and Cory.

Queen Rearing

The Laboratory strain of three-banded Italian bees produced at this Laboratory is being kept intact for improvement shown through the careful selection of mother queens. The hives containing these bees are weighed at least four times a year and oftener if necessary. Two colonies are on scales and are weighed twice each day. The activities of the bees as indicated by the scale colonies and total weighings give the information on which the new breeding queens are selected. During the year a sufficient number of young queens were reared to requeen all colonies and to furnish queens for the overwintering yard of the cooperative project. Alex and Parks.

Queen Rearing For Resistance to American Foulbrood

(In cooperation with Bureau of Entomology and Plant Quarantine, U. S. D. A. and the Iowa and Wyoming Agricultural Experiment Stations)

This cooperative work through 1941 was conducted at six yards made necessary to produce the matings desired. The work commenced the first of March and continued very intensively until the first week in July. As it was thought there might be a great advantage in having fall queens for the first round of testing the next spring, fall queen rearing was attempted. To this end a yard was started the last week in August and three sets of queens produced. These queens are now in full colonies at Hope, Arkansas, and what results may come from fall rearing will not be known until the end of 1942. During the spring seven hundred fifty-six queens were produced, sent to the cooperators and shipped on instructions from Washington to queen breeders. So far as is known at the end of the year this work will continue without interruption during 1942. The breeding queens are at hand and in the hives awaiting the coming of spring. Parks and Alex.

Horsemint For Honey and Oil Production

The year 1941 saw a revival of interest in horsemint for its oil. This plant along with others received a great deal of publicity. Many demands came for information but the interest in the plant was not sufficient to warrant the publication of a bulletin giving the mass of information which has been collected at this Laboratory during the past eighteen years. Parks and Alex.

Plant Survey of the State of Texas

The work which has been done on the plant survey of the State was of great service to many branches of the Government and to many private institutions during the present year. In addition to the former records

a number of plants new to Science were added to the list occurring in the State as well as the first records for known plants being found growing in Texas. The distribution list of individual plants or genera were in great demand from those interested in plants from the economic standpoint. The study made of the distribution of the genus *Yucca* and *Agave* brought to light many new distribution localities and at least two new species. It is hoped that during 1942 the study of these two genera can be completed as apparently these plants will furnish large quantities of much needed drugs. In return for plant identification a collection of over one thousand plants from the Lower Rio Grande Valley was obtained. The information added to that already recorded gives a very complete list of the native plants of that area and of their distribution within the area. Parks, Cory, et al.

Plants For Tannin

The year 1941 was exceptionally favorable to the growth of all tuber-bearing plants. In the tests of Canaigre which have been in progress here since 1922 and since 1939 in cooperation with the U. S. Department of Agriculture, Bureau of Plant Industry, the strain which had its origin in the Carrizo sands in Wilson County showed double the pound production of tubers in comparison with a strain supplied by G. A. Russell of the United States Department of Agriculture, Bureau Plant Industry. Shortly after the tubers were dug and weighed, representative tubers were placed back in the ground for the 1942 test. Parks and Alex.

S. M. Tracy Herbarium

The Herbarium during the present year made considerable progress. Additional specimens were secured by donation and exchange. Some plants collected by those on the staff have been deposited in the Hebarium while others will be placed in the Hebarium in a short time. The total number at this Laboratory to be deposited is about five thousand. Parks.

BOTANY

The identity and distribution of native vegetation is of considerable importance to the study of agricultural problems. Vegetation is an important item in furnishing feed for livestock. Some species of vegetation when eaten are harmful to livestock. Many species have value as honey producers. Plants also act as carriers of plant diseases and in this way have an important relation to agriculture.

The study of native vegetation in relation to livestock industry is centered around the work at the Ranch Experiment Station. It involves principally the occurrence of species which make up the range feed values and the occurrence of species which are harmful to livestock or have low range feed values. The study of the sequence of the different species also widens our knowledge of the extent to which these may affect range feed values.

The work in connection with honey plants is centered at the Apicultural Research Laboratory near San Antonio and is reported under the Division of Apiculture.

The study of vegetation as carriers of plant diseases is centered at Substation No. 5, Temple, primarily in connection with cotton root rot disease work. Some additional work with plants as weed pests is being carried at the Winter Garden Station and at the Apicultural Research Laboratory.

CHEMISTRY

Factors of Soil Fertility—Studies of the fixation of phosphates, the availability of soil phosphates and soil potash to plants, and the forms in which phosphoric acid and potash are found in the soil were continued. Methods for the determination of active phosphoric acid and active potash in soils in lime have been devised. Fraps, Ogier and Fudge.

Soils—Chemical analyses of soils of a number of counties for which analyses have not been published are being made. In cooperation with the Division of Agronomy, a paper on the effect of fertilization on the chemical composition of a Lake Charles clay loam at Angleton has been published. Fraps and Fudge.

Nitrification—A paper entitled "Adaptability of Silica Gel as a Culture Medium" will be published in the Journal of Bacteriology. Silica gel can be used as a base for either organic or inorganic medium for the growth of microorganisms. In case of emergency, silica gel can be used as a substitute for agar. Zinc sulfate, copper sulfate, and mangenese sulfate were not injurious to nitrification even in quantities up to 2 percent. Sodium borate was injurious in quantities of less than 2 percent. Boron is not nearly as injurious to nitrifying organisms as to plants. Vitamin B_1 had neither stimulating nor depressing effect on nitrification. Large accumulations of nitrates were found in soil cultures incubated for six months or more with only a small decrease in organic nitrogen. These gains of nitrogen cannot be attributed to the action of azotobacter since the cultures received no additions of carbohydrates. Fraps and Sterges.

Cotton Root Rot—Cultures of the cotton root rot organism tolerated moderate amounts of salts of tin, tungsten, barium, and strontium, and large quantities of ordinary salt. Iron salts up to 100 parts per million stimulated growth of the root rot organism, and in larger quantities decreased growth. Cobalt, nickel, and titanium in small quantities inhibited growth. Fraps and Simpson.

Relation of Soil Composition to Plant and Animal Deficiencies—A total of 1704 forage samples and 117 soil samples were collected. The work indicates a general deficiency of phosphoric acid in range grasses and sometimes a deficiency of protein during the winter. Crude protein, phos-

phoric acid, and lime have been determined in 180 samples of total herbage and 180 samples of a carpet grass grown on plats at Substation 4, Beaumont, over a two-year period. The results are being prepared for publication. Chlorine in some of the samples of forage is relatively high, particularly in forage from areas of the Gulf Coast Prairie and Rio Grande Plain near the coast. Sodium is very low in most samples and shows little, if any, relation to the chlorine content. The fluorine content of all of the forage samples so far analyzed is usually less than one part per million and is not sufficiently high to cause fluorosis in animals grazing on them. Analyses of forages and grasses show that phosphate fertilization may increase the phosphoric acid content of the plants sufficiently to supply the needs of the range animals. Fudge and Fraps.

Loco Weed and Other Poisonous Plants—The chemical work on loco weed was terminated on September 1, 1941, because of the expiration of appropriations for a chemist. Fraps.

Productive Energy of Animal Feeds—The productive energy of corn meal as measured by gains of fat and protein of growing chickens was found to be 3.00 calories per gram. Work on the productive energy of corn meal, alfalfa leaf meal, dried buttermilk, casein, cottonseed meal, and tankage are published in Bulletin 600. Fifteen additional productive energy experiments and a number of digestion experiments using chickens were made. Fraps and Carlyle.

Productive Energy of Human Foods—The productive energy of human foods is being studied by means of experiments with chickens, since many foods are used both by humans and by chickens. Some productive energy experiments and digestion experiments are also being made with rats. The work on rats and chickens will be applied to human foods when the necessary preliminary work has been done. Data on human digestion experiments are being compiled and studied. Fraps and Carlyle.

Variations in the Vitamin Content of Human Foods—Papers have been prepared or published on the relation of the chemical composition of butterfat to its vitamin A potency; the relation of the chemical composition to the vitamin A potency of livers; the loss of carotene from fresh vegetables during preparation for analyses; and methods of determining carotene in fresh vegetables. A new carotene discovered in yellow corn was found to have a biological potency of one-half that of beta carotene. The liver storage of vitamin A was a little lower in rats receiving meat meal with a high carotene consuming power than in rats receiving meat meal with a low carotene consuming power, indicating destruction of carotene by meat meal of high carotene consuming power in the digestive organs of the animals. Using liver storage of the group receiving meat meal of a low carotene consuming power as 100 percent, liver storage for those receiving meat meal with a high carotene consuming power ranged from approximately 68 to 98 percent. As measured by storage in the livers of rats, utilization of carotene from human foods as prepared for eating

was much lower from boiled carrots, boiled turnip greens, dried apricots, and baked sweet potatoes than from carotene dissolved in oil. With due consideration to loss in preparation, the cost (as of December 1941) of 3000 micrograms of carotene (daily requirements of man) from available sources ranged from 0.5 cents to over two dollars. Mustard greens, turnip greens, spinach, carrots, and sweet potatoes furnished carotene at low cost, whereas cabbage, lettuce, green beans, and butter were more expensive sources. These results are published in a progress report. Cottonseed oil had approximately one-third the vitamin E content of wheat germ oil. Chemical methods for the determination of this vitamin are being studied. Carotene in high potency alfalfa low potency alfalfa, carotene in oil, yellow corn, and cod liver oil all seems to have equal value per U.S.P. unit for maintenance of white rats.

Fraps, Meinke, and Kemmerer.

Quantitative Requirements of Animals for Vitamin A—Crude and pure carotene determinations were made at regular intervals on alfalfa or other feeds used in this work. Livers, blood plasma, and caul fats were analyzed for vitamin A and carotene. Articles have been published or prepared discussing methods for the determination of carotene and cryptoxanthin in yellow corn; the carotenoids in samples of yellow corn of different genetic strains; the quantitative relation of genes of yellow color to the different vitamin A active pigments in yellow corn; the purity and effect of storage on samples of commercial carotene; collaborative A.O.A.C. work for the determination of riboflavin; and collaborative work for the determination of carotene and cryptoxanthin.

The fluorometric and bacteriological methods adopted by the A.O.A.C. tentatively last year for yeast and dried skim milk were adopted tentatively this year for alfalfa also. A method for crude carotene in hays and dried grasses was adopted officially by the A.O.A.C. and a method for pure carotene and cryptoxanthin was recommended to be further studied.

A paper on the effect of various conditions in canning grapefruit juices has been prepared by Dr. W. W. Floyd of Sam Houston State Teachers College, Huntsville, in cooperation with this Division.

Methods for the determination of vitamin A in the presence of substances in feeds which interfere in the spectrographic method for its determination are being studied; also methods for the determination of carotene which do not involve the use of alcohol, which, because of priority rating, cannot be obtained by some laboratories.

Kemmerer and Fraps.

Vitamins in Commercial Feeds—Vitamin D was determined in twenty-eight samples of fish oils or concentrates, vitamin A in sixteen of these samples, and carotene in a number of samples of alfalfa products as published in the Feed Control Bulletin 608. Vitamin B potency of yellow

corn, determination of the carotene-destroying power of feeds, and the riboflavin content of feeds, including cottonseed products, are being studied. Reiser and Meinke.

Investigations of Commercial Feeds—The carotene-destroying power of meat by-products is being studied in cooperation with the Division of Poultry Husbandry to ascertain the extent of the occurrence of crude carotene-destroying power, methods of determining it, and also carotene oxidase, found in legumes, which also destroy carotene, also a study of the mineral content of unmixed and mixed feeds and of commercial mineral feeds, and the determination of blood in animal products.
Reiser, Fraps, and Meinke.

Analyses and Investigation of Commercial Fertilizers—The Chief of the Division of Chemistry is State Chemist and is in charge of the fertilizer law. One thousand and eighteen samples of commercial fertilizers were collected and analyzed, the results being published in Bulletin 607.
Fraps and Ogier.

Chemical Analyses of Commercial Feeds—The estimation of protein, fat, water, crude fiber, and ash, and the microscopic examination were made on about 3600 samples of feed for the Division of Feed Control Service. In addition, hardness tests were made on cottonseed cake; calcium carbonate, salt, calcium, and phosphorus in a number of mineral feeds, and vitamins A and D in fish liver oil and carotene were determined. These results are being published in Bulletin 608 of the Division of Feed Control Service. Fraps and Ogier.

DAIRY HUSBANDRY

Bang's Bacillus Disease (Bovine Infectious Abortion)

The dairy herd of the Feeding and Breeding Station has remained free of Bang's disease during the year, which makes five consecutive years without a reactor to the test for Bang's disease. Breeding performance and milk production with few exceptions have been very satisfactory. Details of the breeding performance can be found in the report of the Division of Veterinary Science. Schmidt and Copeland.

The Quantitative Requirements of Vitamin A for Dairy Cattle

The group fed 1000 micrograms of carotene required an average of 3.25 services per conception, an average length gestation period of 216 days, three calves born dead and one abortion (not brucellosis) and two cows which have never conceived. For the group fed 2000 micrograms of carotene the average number of services per conception was 1.85, the average length of gestation 269 days, 6 calves born dead, 6 died a few days after birth and one lived. For the group fed 2500 micrograms of carotene the average number of services per conception was 1.6 the average length of gestation was 269 days, 5 calves were born dead, 3 calves died a few days after birth and two lived.

Two of the cows have died as the result of vitamin A deficiency from the group fed the 1000 microgram level. One cow died from the group fed 2000 microgram level as the result of infection following calving. Milk production has been exceedingly low in all groups.

Copeland and Fraps.

The Division of Veterinary Science will report on all pathologial data obtained from our vitamin A study. Schmidt and Copeland.

The Effect of Various Temperature Exposures on the Quality of Southern Short Cure Cheddar Cheese

(In cooperation with School of Agriculture,
A. & M. College of Texas)

Cheddar cheese was cured at temperatures of 45°, 60° 70° and 80° F. The cheese made at 60° and 70° cured faster than the cheese cured at 45° F., which reduces the costs of curing. On the average cheese cured at 80° F. was inferior in quality to the cheese cured at the other temperatures. Hanson and Shepardson.

Methods of Manufacture and Other Factors Affecting the Quality of Butter

(In cooperation with School of Agriculture,
A. & M. College of Texas)

During 1940 the chemical analyses were completed on the samples received from the butter plants in the State survey. This survey revealed that the two most common defects of butter produced in the State were gumminess and hardness. There was some indication that these defects might be correlated with the locality of the State as well as with the season of the year. Hanson and Shepardson.

Use of Dried Citrus Peel and Pulp in the Ration of Lactating Cows

(In cooperation with School of Agriculture,
A. & M. College of Texas)

In four out of five experiments completed slightly more milk was produced when the cows were fed corn and cob meal. An average of the five experiments showed the citrus to contain 74.5 therms of energy per 100 pounds, when analyzed for productive energy. The corn and cob meal was slightly more palatable than the citrus pulp since there was no refusal on the corn and cob meal ration compared with a small amount of the citrus ration refused. No effect upon the flavor of the milk was detected as a result of feeding the citrus pulp.

Copeland and Shepardson.

Legume vs. Non-Legume Dry Roughage For Dairy Cattle

(In Cooperation with School of Agriculture, A. & M. College of Texas and Texas Cottonseed Crushers' Association)

This experience has been continued since the last annual report and inasmuch as the cows being fed alfalfa hay were limited to the same amount as the group of cows on sorghum hay, the total hay consumption of each group was equal. The cows, while on the alfalfa hay maintained body weight more satisfactorily than when they were being fed sorghum hay. The milk production was practically equal in each group, the small difference in production being in favor of the sorghum hay group.

Shepardson, Darnell and Copeland.

Milk Substitute vs. Skim Milk for Dairy Calves

(In cooperation with School of Agriculture, A. & M. College of Texas)

Satisfactory growth as measured by live weights and skeletal measurements was made by all calves, however more rapid growth was made by the calves fed skim milk than those fed the substitute. Jersey calves made faster growth on the milk substitute than did Holstein calves. General thriftiness and sleekness of hair was very similar between the calves fed milk as compared with those fed the substitute. The palatability of the milk substitute was good even exceeding that of the skim milk. The incidence of calf scours and other calf ailments was negligible in all calves. Based on current feed prices total feed costs for the calves fed the milk substitute was slightly less than two-thirds of the feed costs of the calves fed skim milk. Copeland and Darnell.

Dehydrated Sweet Potato Meal vs. Ground Shelled Corn For Lactating Dairy Cows

The results of milk production for a single experiment showed .79 pounds more milk produced per cow daily in favor of the ration containing yellow corn. The cows produced 3.08 percent more milk when fed yellow corn than when fed the dehydrated sweet potatoes. Analysis of the data to ascertain the productive energy showed the dehydrated sweet potato meal to contain 78.68 therms per 100 pounds compared with 86.70 therms for the yellow corn. On the basis of productive energy values the sweet potato meal possessed only 90.75 percent of the productive energy value of yellow corn as a feed for milch cows. Butter produced from the cows fed sweet potato meal contained 37.98 international units of vitamin A per gram compared with 31.11 units per gram of butter produced from the cows fed yellow corn. This indicates that sweet potato meal would be an asset to the winter ration of dairy cows as an additional vitamin A supplement. Copeland.

High vs. Low Protein Rations For Lactating Dairy Cows

(In Cooperation with School of Agriculture, A. & M. College of Texas)

This project was started in February 1941, with the object of comparing a high protein ration with a low protein ration. The low protein ration was proportioned to contain the optimum protein in Morrison's Feeding Standard. The high protein ration was composed of the same feeds as the low protein ration, and was so proportioned that it contained approximately 33 percent more protein than the low protein ration.

Three trials have been completed, using the double reversal type of feeding experiment. In the second trial, which was conducted during the summer months of 1941, the cows in the group receiving the high protein ration seemed to suffer more from the hot weather. This was indicated by their appearance and the further fact that during this trial the cows on the low protein ration produced slightly more milk than when they were being fed the high protein ration. During the first trial conducted in the spring and the third trial conducted in the fall, the cows on the high protein ration produced more milk than when they were fed the low protein ration. Combining all three trials, the cows average .93 pounds more milk per day while fed a high protein ration than when fed a low protein ration. Darnell and Shepardson.

Variations in Normal Composition of Milk Produced in Texas

During the past year milk samples have been analyzed from Jersey and Holstein herds over widely separated areas of Texas.

Analyses have been conducted for the determination of fat, protein, lactose, ash, total solids, calcium, and phosphorus. The results indicate that the composition of milk produced in these areas in Texas varies from the results reported in other areas of the United States.

Shepardson, Fuller (G. R.), and Arbuckle.

ENTOMOLOGY

Biology, Control, and Taxonomy of White Grubs, *(Phyllophaga* spp.)

Approximately 500 newly hatched grubs of *Phyllophaga micans, biparta* and *prunina* were isolated for detailed rearing records. A high mortality among all species of grubs occurred in these rearings; those surviving attained maturity by November and are passing the winter in this developmental stage.

Among the grubs carried over from the previous season sufficient numbers of *crassissima* and *farcta* pupated during late summer and early fall to establish the complete life cycle for each species as follows: egg 26 to 35 days; larva 435 days; pupa 26.5 days. The accumulated life history data have been summarized and prepared for publication. Few, if any, grubs,

of the remaining species, *pleroma* and *rubiginosa*, attained the pupal stage; however, from the evidence available both seemingly require two years for completion of the life cycle.

A description of a new wingless species including illustrations of the genitalia and notes on its economic importance are being prepared for publication. Reinhard.

Cotton Insect Investigations

(In cooperation with the Bureau of Entomology and Plant Quarantine, U. S. D. A.)

Boll Weevil—*(Anthonomus grondis)*

The large amount of injury during 1941 was due (1) to a record breaking survival following a relatively mild winter; (2) unusually favorable weather conditions for boll weevil multiplication during the entire growing season and (3) shortage of calcium arsenate and dusting machinery. Experiments conducted n 1941 confirm previous work that applications of calcium arsenate proved effective and profitable against weevils. Thomas.

Control: Where 6, 8, 11 and 12 applications were made using calcium arsenate dust increases in yield of 445, 428, 621 and 626 pounds of seed cotton per acre respectively were made. Only a light bollworm infestation occurred in the second experiment but in the other three, control of bollworm was a factor in the increased yields obtained. By adding .27 percent rotenone for aphid *(Aphis gossypii)* control in the third experiment a a further increase of 123 pounds was obtained in addition to the 621 for boll weevil control.

In some cases aphids were abundant before any applications of poison were made, while at other times eight applications of calcium arsenate on river bottom farms did not cause injurious numbers to develop. Usually where more than eight applications were made some losses occurred. Gaines.

In north Texas increases in yield from the use of calcium arsenate ranged from 110 pounds to 492 pounds of seed cotton per acre. Lowest gains were secured on late planted fields and largest increases were obtained using four applications on bottom land cotton where the untreated areas averaged 914 pounds of seed cotton per acre.

Seven applications of calcium arsenate to thin stands and to normal spaced cotton of the same variety on upland fields for weevil control resulted in an increase of 188 pounds of seed cotton per acre on the thin stand and 243 pounds increase on the normal planting as compared with untreated plats of each. The average weevil infestation throughout the season in the untreated thin stand of cotton was 31 percent and in the untreated normal stand it was 40 percent. Owen and Roney.

Hibernation: Removal of active weevils from hibernation cages was begun on April 16, or approximately one week after young cotton plants first began to appear in local fields. The minimum dormant season temperature affecting the hibernating weevils was 26 degrees F., recorded in November 1940 and in January 1941. This unusually mild winter season was followed by the heaviest boll weevil survival recorded at College Station. Out of a total of 5000 weevils installed, 961 or 19.22 percent passed the winter successfully. Total weevil emergence from hibernation by months was as follows: April 3.64 percent; May 9.4 percent; June 5.76 percent; July .42 percent. For the period 1936 to 1941, inclusive, the average boll weevil survival is 7.38 percent. Reinhard.

Cotton Flea Hopper *(Psallus seriatus)*

In general there was less flea hopper damage in 1941 than has been recorded for a number of years. This was indicated by records which have been taken annually for many years and which showed comparatively small numbers of flea hoppers on weeds in the fall of 1940 and a generally low emergence during the spring of 1941. However, heavy rains in certain areas at critical times greatly reduced infestations which threatened to reach damaging proportions.

Migration and Dispersal: The number of adult flea hoppers caught on seven traps during the spring was low compared to the ten year average. The first adult was taken April 17 about two weeks later than usual.

Flea Hopper Abundance: For several years effort has been made to determine the relation between fall abundance of flea hoppers as indicated by sweeping host weeds and the spring emergence records. Records taken in the fall of 1940 showed only 108 insects per 100 sweeps early in October. The spring emergence in 1941 of 1120 nymphs from 100 of the same weeds was very low. Practically no damgas occurred that year. Records taken in the fall of 1941 showed only a slightly higher number 147 per 100 sweeps than in 1940. Gaines, Owen and Thomas.

Host Plant Studies: Records of abundance of horesmint and the flea hoppers present furnish valuable information on the probability of flea hopper damage to cotton during the same year. Horsemint was growing in stands thick enough to permit sweeping records on 10.6 percent of the distances surveyed. During the period of greatest abundance about the same number of flea hoppers was found on horesmint in 1941 as in 1940. The average per 100 sweeps was 472 and 489 respectively.

There was nearly 50 percent more croton weeds in 15 south central Texas counties in the fall of 1941 than in the fall of 1940. The survey covering practically the same area in the two years showed 17 percent of the distances covered in cotton as compared with 11 percent in 1940.

Fletcher.

Varietal Resistance: The same varieties of cotton were used in the same experimental set-up as in the past few years. Two locations in the Brazos bottom near College, one at Terrell, one at Port Lavaca and one at Waco were selected. The two latter were supervised by Bureau representatives. The flea hopper infestation was low and not considered injurious on any of the experiments excepting those at Port Lavaca. The early maturing variety had the largest number of flea hoppers and also has been producing relatively high yields.

Control: Although the flea hopper infestation was low there was definite evidence that applications of calcium arsenate dust reduced the infestation of both adults and nymphs by half.

Relation of Cultural Practices on Infestation: The flea hopper infestation was low on all plats and differences were small. Records were taken in cotton following cotton, corn, oats, peas, alfalfa, clover and sorghum. Under conditions of light infestations no difference was found in the abundance of flea hoppers on thickly spaced as compared with thinly spaced cotton. Gaines and Owen.

Hibernation: Overwintering eggs in croton weeds in south central Texas began to hatch on March 3, as compared with March 11 during the previous season. Summarized at biweekly periods, the seasonal accumulative emergence of flea hoppers was as follows: March 1-15, 0 percent; March 16-31, .12 percent; April 1-15, 77.16 percent; April 16-30, 86.52 percent; May 1-15, 99.76 percent; May 16-31, 100 percent. Final emergence was recorded on May 23. An average of 1699 flea hoppers was recorded per 100 *C. capitatus* plants. This figure is less than one-third of the average or normal emergence recorded from 1926 to 1941, inclusive. No injurious early season infestations occurred on cotton following this light emergence.

Similar records of hatch from croton weeds collected in Henderson, Hunt, Kaufman and Van Zandt counties were made in north Texas. First hatch was recorded April 2 with the peak occurring during the third week of April. By the end of April 85 percent of the nymphs had hatched in both north and central Texas. In north Texas the average emergence or hatch was 9972 flea hoppers per 100 croton weeds, less than half that of 1939 or 1940. Reinhard and Owen.

Cotton Bollworm *(Heliothis armigera)*

Due to frequent rains during the growing season, cotton was succulent in many areas and attractive to the bollworm moths for oviposition. This pest caused considerable damage particularly on the heavier soils. Since the infestation by young worms was practically continuous during the later part of July and August, the resulting damage became very apparent although the infestation at any one time may not have been especially heavy. Most of the failure among farmers in obtaining control were

due to inability to get into the fields with dusting equipment at the proper time and to faulty application. Some of the difficulties were in not having the nozzles set a little above the tops of the plants and in not properly timing the application to kill worms when young. Airplane application gave poor control of bollworms because the dust was too thoroughly distributed and not cencentrated on those parts of the plants where most of the young worms hatch. Thomas, Gaines, and Owen.

Biological: Because wet weather interfered with planting, corn varied widely in date of maturing even in the same locality. As a result the appearance of bollworm broods was more or less continuous over a longer period. The maximum emergence of worms from corn ears occurred the third week in June in DeWitt county; the fourth week in June in Fayette county, the latter part of June and the first week in July in Brazos and Burleson counties and the first week in August in Dallas and Kaufman counties. The first increase on cotton in the Brazos River Bottom at the points examined occurred July 12 when 17 eggs were found per 100 terminals. Fletcher and Owen.

Control: Results of bollworm control experiments which also include control of weevils are as follows: Eleven applications of calcium-zinc-arsenate produced an increase in yield of 774 pounds seed cotton per acre over the untreated check and 153 pounds increase over calcium arsenate alone. This larger yield from calcium-zinc-arsenate was due to better bollworm control and to delay in the build-up of aphid infestation. Possibly zinc had a beneficial effect upon the plants. In another experiment lead arsenate and cryolites were more effective against the bollworm than calcium arsenate, but the cryolites did not provide as good control of the low weevil infestation as the lead arsenate. Gaines.

Thrips on Cotton *(Franklieniella tritici)*

Comparatively few thrips were taken on screen traps in 1941. From 12 to 22 percent of the plants were found with typical thrips injured terminals. The frequent rains during spring and early summer helped in preventing more damage by this pest. Little difference was found in the amount of thrips injury on early, intermediate or late varieties of cotton.

In north Texas, thrips damage was present in practically all fields and caused an unusually large percentage of deformed plants. Records on 25 fields showed damage, as indicated by "thrips" or deformed plants, to average 30 percent. Owen and Gaines

Miscellaneous Cotton Insects

In cage studies in the El Paso Valley it was found that *Adelphocoris superbus* and *Lygus hesperus* caused shedding of squares and bolls of less than 20 mm. in diameter, and proliferations inside the burr and staining of lint in large bolls. Both species deposited eggs in bolls and caused split-

ting of the carpels. *Chlorochroa ligata* severely damaged Acala and SXP bolls.

The infestation of these insects was found to be fairly uniform in cotton as far as 125 rows from alfalfa. The insects disperse from alfalfa fields soon after mowing and appear to scatter widely within a few days. Most of the injurious species were more abundant in alfalfa seed fields than in hay fields or in cotton, particularly while the seed were in the dough stage.

Jones.

Rapid plant bugs, *Adelphocoris rapidus*, and stink bugs, *Nezara viridula*, caused damage to square and young bolls. The stink bugs not only injured the young bolls, but gave bacterial rot an opportunity to enter thus causing considerable loss to late bolls. Vegetable weevils, *Listroderes obliquus*, were noticeable on seedling cotton, but in no case was injury observed that could be attributed to this pest. Gaines.

Plant Performance Studies

In 1941 in an average upland cotton field there was about as much normal shedding of uninjured squares as setting of squares on both dusted and untreated plots after the first of August. Dusting of cotton after this date served only to protect the young bolls.

Roney and Thomas.

Pink Bollworm

Field Infestation: The average infestation in the Presidio Valley was about the same in 1941 as in the last 2 years. The year-to-year records show that the infestation during the last 3 years was greatly reduced from that previously prevailing. This reduction followed the 1938 flood and the initiation of the Bureau's control program consisting of fall clean-up, regulated planting date (no cotton planted prior to April 20), and the planting of early, fast-maturing varieties. Also the thorough fall clean-up and the hand picking of surface debris, followed by winter plowing and irrigation of a few of the fields that were most heavily infested last year, contributed to the marked reduction in the infestation of these fields in 1941. Green-boll infestation counts made in the El Paso Valley in October showed an infestation ranging from 0 to 34 percent and averaging 9 percent. At Brownsville it appears that the infestation in 1941 was reduced to about the level of 1936, the year it was first discovered in the Lower Valley.

Hibernation Experiments: The maximum duration of the resting stage, that is, from the time the bolls were installed until the last moth emerged at Brownsville was as follows: Bolls on standing stalks 260 days (September 25-June 11), open bolls on soil surface 189 days (September 26-April 2, green bolls on soil surface 205 days (October 28-May 20), and green bolls lightly buried 141 days (October 28-March 17).

Parasites: Introduced parasites were reared and released in the Presidio Valley as follows: *Chelonus blackburni* Cam. 85,000, *C. pectionphorae* Cush. 55,000, *Microbracon kirkpatricki* Wilkn. 18,185, and *M. mellitor* Say (Hawaiian strain) 385. Colonization of *C. blackburni* and the Hawaiian strain of *M. Mellitor* was terminated at the end of this season, as it was thought that these species had been given sufficient opportunity to become established.

Insecticide Experiments: No control was obtained with nicotine oil sprays as ovicides and very little, if any, control occurred from the use of cryolite and basic copper arsenate. Cuprous cyanide diluted with 25 percent celite and a special cotton dust containing 10 pecent of xanthone and 90 percent clay applied in nine applications at 4-day intervals caused about a 50 percent reduction in the number of larvae per boll. However, these two dusts caused severe burning of the foliage.

Cotton Varieties: The variety test again compared three quick-fruiting, early-maturing eastern varieties developed for boll weevil conditions and a slow-fruiting western variety developed for growing under irrigation. A heavy pink bollworm infestation developed in this test, and all green bolls set after September 16 were completely destroyed. The quick-maturing varieties averaged 1,493 pounds of seed cotton per acre and the late-maturing variety only 830 pounds. Chapman, et al.

Sulphur as an Insecticide

(In cooperation with the Texas Gulf Sulphur Company and the Freeport Sulphur Company)

Progress in this project is reported under Substation 15 and 19, the Laboratory for Truck Crop Insect Investigation, and under Fruit and Nut Insect Investigation.

Devil's Shoestring *(Tephrosia virginiana* **(Linn.)), as an Insecticide**

(In cooperation with the School of Agriculture, A. & M. College of Texas, and the Bureau of Plant Industry, U. S. D. A.) More data on the percentage of rotenone and total extractives as influenced by the seasons has been obtained. The work has been continued on inheritance of rotenone with results approximating those of the previous season. Plants grown from inbred seed showed a marked loss in vigor in comparison with those grown from seed obtained by open pollination the past season.

The work with crown cuttings, both in the field and the greenhouse, was continued with excellent results. Methods are being worked out for rapid propagation by this means with very encouraging results. Rather extensive field tests with cuttings treated with indolebutyric acid were made with indifferent results. Since America's supply of rotenone and rotenoids is being threatened, every effort is being made to increase as rapidly as possible by cuttings and seed from the best strains so that if

it should become necessary this stock will be available for commercial plantings. Little.

Fruit and Nut Insect Investigations

Pecan Nut Case Bearer *(Acrobasis caryae* **(Grote)):** Experiments were conducted with dormant sprays to determine their effect on the overwintering hibernacula of the pecan nut case bearer. Oil sprays to which dinitro-o-cyclohexylphenol was added in varying amounts were applied at 2 and 4 percent strengths.

A proprietary product composed of 40 percent dinitro-o-cyclohexlphenol, 40 percent bentonite, and 20 percent soybean flour was added to the oil in the spray tank after the oil was emulsified. The oil was emulsified with a mixture of 50 percent bentonite and 50 percent goulac which was added at the rate of 1¼ pounds to each 100 gallons of water.

12,359 hibernacula were examined. About 95 percent control was obtained with an emulsion containing 4 percent oil and .12 percent dinitro-o-cyclohexylphenol. When the dinitro-o-cyclohexyphenol was reduced to .06 percent the amount of control varied 41 percent to 73 percent, depending to some extent upon the type of emulsifier used. Bilsing.

Plum Curculio *(Conotrachelus nenuphar* **Hbst.):** The fruit insect control program started at Nacogdoches in 1940 and was extended to two other areas in the state during 1941. The materials used were as follows: Zinc Sulphate 4 pounds, Lime 8 pounds, Sulphur 6 pounds, Lead Arsenate 2 pounds and Water to make 100 gallons.

The overwintering adult curculios did not attack the peaches in the vicinity of College Station until after the shucks were off the fruit. Three spray applications were made. Harvest records show that less than two percent of the sprayed fruit and over 68 percent of the fruits on the unsprayed trees were infested with plum curculio.

Jarring records for presence of curculio near Stephenville showed that the peaches in the two sprayed orchards did not need treatment until two weeks after the "shuck off" stage. Though as many as 300 curculio adults were jarred in a season from one of many plum trees, the weevils did not attack peaches in the same orchard.

At Nacogdoches the curculios appeared on peach trees when about three-fourths of the blossoms had fallen. In 1940 their appearance was not until after "shuck off."

These records emphasize the importance of "jarring" to determine the time of spray applications.

McGregor (In cooperation with Substations 11 and 20.)

Oriental Fruit Moth *(Grapholitha molesta* **Busck):** More than 65 percent of the fruit ripening after July 20 in the Nacogdoches orchard were in

fested with larvae of Oriental fruit moth. Preliminary plans have been drawn up for release of parasites in cooperation with the Bureau of Entomology and Plant Quarantine, U. S. D. A.

McGregor (In cooperation with Substation 11.)

Bark Beetles *(Stephanoderes ficus* **Hopk.)**: Carefully pruned, well kept fig orchards showed less infestation by bark beetles than poorly kept orchards. The bark beetles continue to breed in branches removed from the trees in the pruning process and it is desirable to burn all pruned out wood in order to reduce the infestation as much as possible. Janes.

Truck Crop Insect Investigations

The work of the laboratory at Alta Loma in Galveston County and investigations at College Station are reported below; other work on truck and citrus crops is presented in the reports of Substation 15 and 19.

Cabbage Looper *(Autographa brassicae* **(Riley))**: Cube sulphur dust. 5% rotenone and cube spray .025% rotenone, gave approximately the same degree of control of the cabbage looper on cabbage. Five applications of the insecticide were made during the period of investigation. The degree of control was reduced by frequent rains. An analysis of the infestation records showed the average kill produced by the cube-sulphur dust to be 80 percent and the cube spray 84 percent.

Flea Beetle *(Phyllotreta vittata discedens* **(Wise))**: Four applications of insecticides on mustard for the control of flea beetles produced the following net profits per acre: Cube-sulphur dust containing .5% rotenone, $57.33; cube spray containing .025% rotenone $64.44; nicotine-gypsum dust containing 1.5% nicotine $26.54.

Turnip Aphid *(Rhopalosiphum pseudobrassicae* **(Davis))**: Rotenone bearing dusts, Pyrethrum bearing dusts, Rotenone spray and "Nicotrol" spray was each effective in the control of turnip aphid, especially during warmer weather. During cool weather "Nocotrol" spray gave considerably better control than any of the other materials. Concentrated pyrethrum used at a strength of .2% pyrethrins was more effective than when used at .1%, and cube dust containing 1% rotenone was more effective than dusts of lower rotenone content. Jones.

Squash Bug *(Anasa tristis* **(De Geu.)**: Concentrated pyrethrum containing 2% pyrethrins, tobacco dust containing 10% nicotine alkaloid, and cube containing 5% rotenone were used in preparing dust mixtures containing .2% pyrethrins, .3% nicotine and .1% rotenone respectively. Pyrax ABB was used as the diluent in each case. The dust mixture containing .2% pyrethrine gave 95 percent kill of both adults and nymphs and was more effective than either the nicotine or the rotenone. Usually three applications at 7 to 10-day intervals, applied at the rate of 30 pounds per acre per application were necessary for control.

Potato and Sulphur Injury: Dusting sulphur, wettable sulphur and liquid lime sulphur were used. At College Station liquid lime sulphur, 2 gallons to 100 gallons of water severely burned the foliage. This material did not injure the plants at Lubbock. The sulphur dust or wettable sulphur spray, 6 pounds per 100 gallons of water, produced no injury at either place. Roney and Jones.

Miscellaneous Insect Investigations

Ornamentals: Thrips on roses: The same spray used for control of gladiolus thrips, i.e., tarter emetic 2 oz., brown sugar ½ lb., water 3 gals., was found to be effective in the control of thrips on roses.

The leaf crumpler: Five hundred nests of *Miniola indigenella* were examined from five localities in Brazos and Burleson counties. Less than 1 percent of these nests contained overwintering larvae. This insect has been spreading and causing considerable damage to plums, pyracantha and Crataegus. Fletcher.

Apiary Inspection for 1941

During the year inspection work was conducted among 472 beekeepers located in 57 counties. Examinations were made of 32,018 colonies of bees and 312 cases of American foulbrood were found and destroyed, showing an infection of 0.9 percent. Of the total number of men visited, 152 received their first visit and inspection; of those receiving their first inspection, 28 men or nearly 20 percent were found to have disease present in their colonies. The American foulbrood infection found among the colonies owned by these 28 men was nearly 30 percent.

Among the beekeepers inspected were 33 who requested and received Queenbreeder's certificates and 8300 shipping tags.

Work was done for the first time in Blanco, San Augustine and Shelby counties and in Smith county for the first time since 1920.
O'Neal and Thomas.

FARM AND RANCH ECONOMICS

Regional Agricultural Adjustment

(In cooperation with the Division of Farm Management and Costs, Bureau of Agricultural Economics, U. S. D. A.)

Since this project was revised during the latter part of 1941, a final report of results in summary form will be made at this time:

1. The State has been divided into 18 major type-of-farming areas on the basis of differences in land resources and in methods of farming. A description of these areas and related information has been published in Texas Agricultural Experiment Station Bulletin No. 544, A Description

of the Agriculture and Type-of-Farming Areas in Texas. The information contained therein has been useful to research workers in other fields in providing recognized limits for the generalization of the results of research. Extension programs have been adapted to the differences in resources and types of farming as delineated and described in this bulletin. The information has also been useful in the administration of Federal agricultural action programs in the State.

2. Basic information useful in the planning of adjustments on farms has been developed for: (a) the High Plains Cotton Area, (b) the Rolling Plains, (c) the North-Central Grazing Area, (d) the High Plains Wheat Area, and (e) the Black Prairie Area. This information includes production requirements and production practices for the various alternative uses of land, the more important factors affecting income, the relation of variations in soil type to land use and land management, conservation practices and their effect on production, the optimum acreages of cropland that can be handled by an average family with different types of power and the common sizes of power and equipment units, and consumption of farm raised products in the home. The information for each area except the High Plains Wheat Area has been summarized and published or is in some stage of publication.

This information has proven useful to farmers in the selection of a size and type of power unit and in planning adjustments in the size and organization of their farms. It has also been useful to those agencies engaged in individual farm planning, such as the extension service, the Farm Security Administration and the Soil Conservation Service.

A study of the Gulf Coast Area was initiated during 1941. Soils maps were prepared for a complete cross section of the area in cooperation with the Soils Survey Division. Estimates of the cost drainage in the various drainage basins of this cross section were obtained through the cooperation of the drainage section of the Soil Conservation Service. Progress Report No. 754. Estimates of Cost of Drainage for Matagorda, Wharton, and Colorado Counties, Texas, gives a brief summary of the results of the drainage survey. Detailed information pertaining to the organization and operation of the farm was obtained on 375 farms in the area. These farms were carefully selected to represent the different soil types and types of farming found in the area. The analysis of these data is being completed under the revised project.

Bonnen and Magee.

Land Use Adjustment in West Cross Timbers

Report on this project is included in the report for Substation No. 20.

Langley, Bonnen, and Czarowitz.

Operating Costs and Financial Conditions of Gins in Texas

(Insofar as this study deals with cooperative gin records for the seasons 1932-33 to 1935-36, the project is in cooperation with the Cooperative Research and Service Division of the Farm Credit Administration)

A manuscript was completed during the year which is being published as Bulletin 606, Cost and Profit of Ginning Cotton in Texas. A section of this bulletin has been prepared especially for persons primarily interested in the practical use of the cost and profit analysis. Means are provided for appraising the ginning industry of Texas in terms of the present ginning capacity, investment in the gin plants, volume of cotton production, and gin income. This phase of the analysis is suggestive as to needed adjustments in the ginning industry to insure a stable and efficient ginning business in Texas.

A study is being made of all cooperative gins financed by the Houston Bank for Cooperatives regarding their progress in paying for their gin investments. Members of 246 cooperatives made an average down payment of 9.8 percent of the investment at the time of organization. But members of 131 of these associations made no down payment.

Paulson and Gabbard.

A Study of the Marketing of Turkeys in Texas

An analysis has been made of data collected on 27,317 turkeys sold in the Thanksgiving market of 1940. Young toms and hens constituted 94.0 percent of all the birds. Of the young birds, 91.4 percent graded No. 1. The average weights per bird of young toms and hens were 15.1 and 10.4 pounds on No. 1's and 12.6 and 8.3 pounds on No. 2's.

The average prices per pound received by producers on No. 1 toms and hens were 12.3 and 13.7 cents and on No. 2 toms and hens 8.8 and 10.3 cents.

This study is now being conducted in cooperation with a turkey marketing project in the Division of Poultry Husbandry. Paulson.

A Study of Cooperative and Private Grain Elevators for Developing Standards of Performance as to Membership, Finances and Operation in the State of Texas

(In cooperation with the Cooperative Research and Service Division of the Farm Credit Administration)

Operating statements, balance sheets, and other information were obtained from 31 cooperative elevators. The Farm Credit Administration is making the analysis of the financial aspects of the study. The Texas Agricultural Experiment Station is making the analysis of the cost aspects and of the general information gathered in the questionnaire.

Average margins realized on the grain business per bushel were: wheat, 4 cents; grain sorghums, 8 cents; and other grains, 5 cents. Average margins on supply business were: coal, $2.00 per ton; and sack feeds, 15 percent on the cost.

One-half the members of the cooperative elevator associations are tenants. One director of every fourteen is a tenant. In most instances, the membership of the board of directors is the same as at the time of organizing the cooperative elevator association several years ago.

Paulson.

Factors Affecting the Equitable Assessment of Rural and Urban Property

(In cooperation with the Division of Land Economics, Bureau of Agricultural Economics, U. S. D. A.)

A. At the request of and in cooperation with the county land use planing committee, a study of assessments and collections of property taxes in San Saba County was undertaken. The field work was completed in 1940. In 1941, the data were tabulated, summarized, analyzed, and published in a mimeographed preliminary report. The findings revealed gross inequalities in the assessment of both rural and urban properties. There was a strong tendency to assess small properties higher than large properties. Intangible properties were found to make up 25 percent of all taxable property and only 3.4 percent of it was taxed. Delinquencies amounted to three-fourths of one year's revenue.

B. During the year, in cooperation with the Bureau of Agricultural Economics, a brief summary and appraisal of Texas property laws and their administration has been prepared in tentative form. The plan is to publish this report in some form during the coming year.

C. The collection of data from representative counties throughout the State on the trend of taxes on farm and ranch lands has been continued. Incomplete data for 1941 indicate a slight decrease in the tax per acre as composed with similar figures for 1940.

Gabbard and Hervey.

Factors Affecting the Collection and Expenditure of Taxation Revenues in Texas

As one of the major phases of this project, a study of county budgeting was made during 1941. The results were presented in Bulletin No. 603, Budgeting in Texas Counties, 1931-940, published September 1941. The purpose of the study was to determine the results which have been obtained by Texas counties under the uniform budget law passed in 1931.

It was found that 82 percent of the counties have prepared budgets annually. An analysis of 231 current funds for the year 1935 revealed that 83 percent lived within their incomes. An analysis of 100 funds in

1939 showed that 92 percent lived within their incomes. This indicates a marked improvement in local governmental expenditures.

As a result of this study, the following suggestions were made:

1. State and local officials should continue their efforts to arrive at a common understanding of the law.
2. A manual of instructions should be prepared in order to demonstrate the manner of estimating and presenting the information essential to a budget.
3. A field force should be provided by the State, whose duty would be to determine the best budgeting procedure, and to work closely with the county officials on their budgeting problems.

Local Governmental Purchasing

Another specific phase of Project No. 405, that of local govenmental purchasing, was begun during the year. The purpose of this study is to describe the methods and procedure of selected outstanding systems of purchasing by local governmental units and to indicate the savings that may be realized through them, with the view of assisting local units in general to devolp more efficient purchasing systems. Thus far, purchasing systems or methods of purchasing in McLennan, Brazos, Grayson, and Wharton counties have been studied. A preliminary analysis reveals that each of these counties is making full use of specifications. Each county secures the lowest prices by making full use of competitive bidding. A study of bids received revealed that savings of approximately 20 percent were made on materials, supplies and equipment bought under centralized purchasing as compared with the usual ordinary purchases. By contracting for gas, oil, and grease, one of the counties reduced costs from $11,251.68 in 1937 to $7,871.51 in 1939. The potentialities of effective and efficient purchasing by local governmental units in Texas are great when applied to 254 counties spending annually 50 to 60 millions of dollars. Bradshaw, Hervey, and Gabbard.

Economic Significance of Land Tenure

This project was revised during the year so that a more fundamental approach to land tenure might be undertaken. An effort is being made in specific type-of-farming areas to discover how the different tenure groups vary as to their efficiency in utilizing farm resources. Recommendations based upon this analysis will be made for improving the tenure system. More than 200 detailed schedules were completed in Kaufman County, which was selected as typical of the Black Prairie area.

A study of type of farm tenancy areas, conducted cooperatively with the Bureau of Agricultural Economics, was completed in July. A report, Type of Farm Tenancy Areas in Texas, was released in October. Seven

major tenancy areas were delineated and described in the publication and an appraisal of further needs in farm tenancy research was outlined.

Landlord supervision was found to be a highly important factor in the operation of rented land. Close supervision characterized the tenure system in East Texas and the Gulf Coast area. Absentee ownership was most prevalent in the Panhandle where 53 percent of the landlords were non-resident persons or organizations. More than one-fifth of all the farm land in the State was found to be held by absentee owners. A wider use of written farm rental agreements was evident from reports applying to the 1939 rental year, at which time 16 percent of the agreements in force were written memoranda or full-fledged contracts.

A report on farm population movements with particular reference to their relation to land tenure changes was made in Progress Report No. 749, Texas Farm Population Changes During 1940. Net farm population losses during 1940 amounted to 10,000 persons. On January 1, 1941, a population of 2,123,000 remained on Texas farms.

An expansion of the land tenure project during the next three years will be made possible by a grant from the General Education Board to the Southwestern States. Through a plan of informal cooperation, each state will be enabled to increase the scope of its work and at the same time secure a product for regional analysis.

Considerable emphasis has been placed upon farm labor during the year because of a threatening shortage. In response to numerous requests for reliable factual information about the supply of and demand for labor, facts about wage rates, and related data, regular reports have been obtained from all parts of the State and all agricultural agencies. State-wide summaries of labor conditions have been released monthly. Motheral and Gabbard.

Land Use in Relation to Sedimentation in Reservoirs in the Trinity River Basin

(In cooperation with the Soil Conservation Service, U. S. D. A.)

The purpose of this study was to determine the effect on siltation of reservoirs in the Trinity River Basin of the use of approved erosion control measures on the uplands which drain into these reservoirs.

It was found that total damage to reservoirs in the Trinity River Basin caused by siltation amounts to approximately $165,000, of which $90,000 could be prevented by the application of approved erosion control practices on two-thirds of the total land area of the reservoir watersheds. For example, Kaufman Lake is silting at a rate of 6.6 acre feet a year, which limits its life to 37 years. The application of an approved conservation program to as much as 90 percent of the watershed area would increase the life of the lake to 74 years. The study reveals that both

farmers and townsmen may be expected to benefit substantially from an erosion control program in reservoir watersheds. In this connection, annual farm benefits of a complete erosion control program in the watershed of Kaufman Lake are estimated at $810 and benefits to the town at $425. The total initial cost of a complete erosion control program for Kaufman Lake watershed is estimated at $5,000, including increases in annual maintenance. The total of farm and town benefits of $1,235 would amortize the $5,000 at 6 percent interest in five years. The results of this study were published in Bulletin No. 597, Land Use in Relation to Sedimentation in Reservoirs, Trinity River Basin, Texas, issued in 1941.

Garin and Gabbard.

FEED CONTROL SERVICE

Inspection

The usual inspection of feeding stuffs has been continued during the past year and seven inspectors have visited feed manufacturers, feed dealers, and a considerable number of consumers in order to secure official samples for analysis and to detect possible violations of the Texas Feed Law. Several trips were made from the office for the purpose of carrying on special investigations.

Computed from the sale of feed inspection tags, there were 1,814,092 tons of feed sold in the State during the fiscal year ended August 31, 1941, which is the largest amount on record, increasing steadily during each of the past nine years with one exception. Cooperation with the Food and Drug Administration of the Federal Security Agency has been continued and thus control exercised over inter-state shipments of feed as further protection to Texas feed purchasers.

Samples

During the fiscal year the inspectors secured 3,529 official samples of feed, which were subjected to chemical analysis and microscopic examination by the Division of Chemistry. Quite a few samples of vitamin A and D carriers were assayed, cottonseed cake tested for hardness, and carotene, salt, and carbonate of lime determinations were also made on many samples. When analyses are completed, they are reported to all parties interested as soon as practicable after the results are available.

Shipments Withdrawn from Sale

During the year covered by this report 1,774.71 tons of feed were withdrawn from sale by dealer and manufacturers on advice of this Division because of the fact that the shipments involved did not meet the requirements of the law. After proper adjustments were made, sale was resumed.

Violations

During the year eight complaints were filed with the County Attorneys against manufacturers violating certain provisions of the Texas Feed Law. Seven of these cases were settled by payment of fines and docket costs, amounting to $564.85. One case is now pending.

During the year there were two Federal cases developed against manufacturers shipping feed into this State in violation of the Food, Drug and Cosmetic Act of 1938. The necessary evidence in each case was transmitted to Federal authorities for legal action. These cases were then referred to United States attorneys having jurisdiction and prosecution of violators recommended. One of the cases was terminated by the payment of fine of $500.00 and docket costs, and the other case is still pending.

Information has been received from Washington, however, that two cases developed previous to September 1, 1940, were terminated on payment of fines amounting to $200.00.

Six hundred and twenty-four minor complaints were adjusted through correspondence, together with the assistance of the inspectors. These complaints consisted of untagged shipments of feed; improperly labeled shipments; incorrectly printed tags attached to packages of feed; short weights; deficiency in crude protein; excess of crude fiber, and other minor irregularities.

Cooperative Research Projects

Allotments of funds of the Division for research projects to assist in the proper and adequate administration of the Texas Feed Law were made to the following Divisions of the Texas Agricultural Experiment Station:

Division of Chemistry
- Chemical Analyses and Investigations of Commercial Feeds
- Vitamins in Commercial Feeds
- Relation of Soil Composition to Plant and Animal Nutrition

Division of Dairy Husbandry in Cooperation with the Department of Dairy Husbandry, A. & M. College
- High Versus Low Protein Rations for Lactating Dairy Cows

Division of Farm and Ranch Economics in Cooperation with Subtion No. 20
- Land Use Adjustment in the West Cross Timbers Region

Division of Poultry Husbandry
- Quality in Turkeys as Affected by Nutrition, Environment and and Breeding
- Protein Requirements for Chick Rations
- Maximum Crude Fiber Content Allowable for Chick Starters
- Maximum Fat and Free Fatty Acids and Their Effects on Chick Protein Rations

Pullet Development Rations, Particularly as Differentiated from Brooder Rations
Carotene Destroying Power of Feed

Division of Swine Husbandry
A Study of Amino Acids in Cottonseed and Cottonseed Meal

Division of Veterinary Science
Testing Manufactured Feed Samples for Poisons or Other Harmful Substances

Fuller and Sullivan.

HORTICULTURE

Fruit Adaptability Tests

A new blackberry from Corpus Christi has shown resistance to heat at the Winter Garden station. Additional varieties of peaches for the home orchard that have done well at Substation No. 11, Nacogdoches include C. W. Cartwright which is an early yellow cling for local use, Marigold, A. A. Schilling, an attractive early yellow freestone, Fisher and Cumberland—all ripening before the middle of July. Of the later varieties Vedette, Valiant, Viceroy, Veteran, Redelberta and Viola can be recommended for home planting. Varieties averaging over 2 bushels per tree at the Wichita Valley station this season are Berta Ross, Dr. Burton, Frank Halberta, Hart Cling, and Smith Indian. Crawford's Late, Early Rose, Flaming Gold, and Halehaven produced nearly as well. This work is being extended to Substation No. 20, Stephenville. Because nearly 18 percent of the 540 peach trees purchased for the test at Nacogdoches were untrue to name, budwood has been secured from known trees wherever possible and propagated at Stephenville for the test at that point.

Yarnell, Rosborough, Ratsek, Picket, Denman, Randolph, and Substation Superintendents.

Berry Breeding

At Substation No. 11, Nacogdoches 27 selections have been made from 250 seedlings of intervarietal crosses. The outstanding plants are from a dew-blackberry cross and from a Young-blackberry cross. At College Station selections of Ness backcrossed to dewberry and to raspberry have been propagated by means of single-bud stem cuttings under a mist for a yield test. In general, the backcrosses to the dewberry propagate much more readily than either the Ness or its backcross to the raspberry.

Morris and Yarnell.

Citrus

Adaptabiliy and Breeding: A new late tangelo (52013K12G) is promising for the Winter Garden area. It is unusually large and attractive in appearance. A study of citrange and citrumelo seedlings at College Sta-

tion discloses 3 classes of each with respect to amount of segregation. Of the citranges 11 varieties have under 1% of segregating seedlings, 1 gave about 6% and 3 over 95% of segregating seedlings. Comparable figures for the citrumelos: 5 varieties with less than 1% segregation, 6 varieties 10% of whose seedlings are segregates, and 6 varieties averaging 72% of the seedlings segregating. Non-segregating seedlings are indistinguishable from the F_1 and presumably result from nucellar budding which is common in citrus.

Mortensen, Friend, Wood and Yarnell.

Citrus Rootstocks: At the Winter Garden station a study of seedling production of a number of citrus types of possible rootstock value has been made because of the practical importance of availability of material in nursery practice. Results are discussed in the report of Substation No. 19. Mortensen.

Culture Studies: Both 16-20-0 and ammonium sulfate alone applied 8 to 10 pounds per tree gave higher yields of grapefruit at the Lower Valley station than did 10-pound applications of 10-30-10 or 20-pound applications of 5-15-5. Friend.

Adaptability of Date Varieties

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

A total of 4483 heat units were required to ripen Amri and Koroch varieties at the Winter Garden station. Amir Haj and Kustawy ripened normally in spite of high humidity at that point. At the Lower Valley station fumigation with 1 part carbon tetrachloride and 3 parts ethylene dichloride did not hasten ripening. Treatment from 24 to 48 hours was found to improve the quality. Mortensen and Wood.

Figs

Adaptability and Breeding: The variety adaptability planting is at Substation No. 3 on the Gulf Coast. At the Main Station the seedlings are being classified as to sex and a number of other characters including rust resistance. Reed and Yarnell.

Processing: For an account of this project turn to the report of Substation No. 3. Reed.

Grapes

Adaptability and Breeding: The wet season gave an opportunity to observe varietal differences in resistance to black rot. Those most resistant include the varieties of Muscadine grapes, the Dog Ridge selection of *Vitis champini*, Champanel, Carman, Ladano and Favorite.

Randolph, Mortensen, and Yarnell.

Rootstosks: Work is under way at the Winter Garden station (No. 19) and at the Fruit Investigations laboratory in Montague county. The LaPryor selection has shown promise as a stock at both points, although Dog Ridge and Champanel do better in some combinations.

Mortensen, and Randolph.

Cultural Tests: Reports are included with others of the Fruit Investgations Laboratory. Randolph.

Processing Experiments: This work is being done at Substation No. 3, Angleton in cooperation with the Fruit Investigations Laboratory.

Reed and Randolph.

Papayas

Seedlings from Hawaii and South America and selections from a Lower Valley planting were grown together with several intervarietal crosses at Substation No. 15. Wood.

Peaches

Breeding: Several crosses between commercial and Honey varieties fruited for the first time during the past season. Selections for crossing back to the commercial type were based on flowering behavior after a comparatively mild winter, on tree vigor and on size and quality of fruit. Some 20 such crosses were made at Substation No. 11, Nacogdoches, using pollen from these trees on early yellow freestone varieties having shipping quality. Yarnell, Morris, and Pickett.

Cultural work is still in its early stages and is being carried on at Substation No. 16 in the Wichita Valley, at the Fruit Investigations Laboratory, and is being extended to Substation No. 20, Stephenville. A part of the work at the first location consists of pot experiments on methods of handling orchard soils. Picket, Randolph, and Denman.

Rootstock: Material is being collected for a rootstock test at Substation No. 20, Stephenville. Denman.

Plums

Breeding: Three hundred eighty-four mature fruits or 8.3 percent good sets, resulted from 4700 intervarietal pollinations in 1941. Munson and Burbank were again the outstanding seed parents. Munson x Santa Rosa is considered one of the most desirable combinations made this year. Other crosses producing more than the average percent of seed were: Bruce x *Prunus angustifolia* (26.7%; Burbank x Cumberland (16.3%); Golden Beauty x Poole's Pride (15%); Burbank x Poole's Pride (14.8%); Munson x Shiro (12.2%); Golden Beauty x Cumberland (11.1%); and, Munson x Wickson (9.6%). Pollen of the native tetraploid *Prunus carolinianum* was used on 6 diploid varieties in an attempt to synthesize—from forms adapted in the Southwest—a fertile, hexaploid similar in method of origin and in quality to the European plums which are unadapted here.

Self-sterility Studies: Bruce, Cumberland, Gold and Munson were each self-pollinated with no sets resulting. Bruce is completely self-sterile, at least under controlled emasculation and hand pollinating conditions. Observed high insect populations and close proximity of abundant native plum thickets (mostly *P. angustifolia)*, shown under control to furnish pollen excellent for fertilizing Bruce, suggest one obvious explanation for the good sets obtained in single-variety orchards. Flory.

Pollen Studies: Neither season nor location of trees had any significant effect on apparent viability of pollen. There was a highly significant correlation ($r = .845$) between apparent viability and actual germination when the varieties studied from both standpoints were considered together. Pollen size was found to be not only consistent within a variety, but is very apt to be similar between closely related forms. Analysis of variance shows that while there are significant pollen size differences between varieties within some of the size groups, the great majority of the variance encountered is intergroup.

Flory and Tomes.

Varietal Resistance to Canker: The 45 plum varieties in the Main Station orchard have been rated in 2 consecutive years for resistance and susceptibility to canker, apparently caused by *Bacterium pruni.* Twenty of these have been highly resistant to canker, 4 highly susceptible, with the other 21 varieties being rated in 7 intervening classes. Flory.

Strawberries

Adaptability and Breeding: Besides Alamo, Ranger and Rio Grande four unnamed selections T 22, T 72, T 365 and T 553 seem to be especially resistant to wet weather during the production season at the Winter Garden station. Ranger over-summered under mulch much better at College Station than Klondike, Missionary and several selections. However, T 22 was fairly satisfactory in this respect and is a home garden sort of very high quality. Mortensen.

Culture: Ranger is being given differential fertilizer treatments at Substation No. 2 in Smith county. At the Wichita Valley station lime increased the yield while barnyard manure decreased the yield of strawberries. Ratsek and Pickett.

Improving Growing Conditions of Horticultural Plants

A new project has been started at Substation No. 20, Stephenville, with the purpose of studying ways of improving the growing conditions of plants, especially during the drier portions of the growing season. These include the stimulation of the root system of newly set or of annual plants by means of fertilizing starter solutions, the reduction of the rate of transpiration by wax and other sprays, and the improvement of the soil by the addition of various composted materials. The plants used in the tests are zinnia, tomato, rose and peach. Denman.

Truck Crop Adaptability Tests

The new hybrid sweet corns are giving a good account of themselves at the Lower Valley station. The heaviest producing varieties of edible soybeans at that point are Hokkaido, Giant Green, Willomi, Emperor and Sousei. Idaho Refugee snap bean yielded the best of 8 varieties tried. U. S. No. 5 Refugee rated second. Selections have been made from several nematode resistant beans received from the U.S.D.A. Regional Vegetable Breeding Laboratory. At the Wichita Valley Station Resistant Detroit was the earliest and most productive variety of cabbage; Jersey Queen ranked next. Head lettuce is receiving increased attention in the Winter Garden. Imperial 152 is one of the earliest and firmest varieties. Imperial 44 is second. The test at Substation No. 20, Stephenville included tomatoes, edible cow peas and watermelons.

Friend, Wood, Pickett, Hawthorn, and Denman.

Vegetable Variety Descriptions

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

This work is being carried on at Substation No. 19 in the Winter Garden area. Hawthorne.

Cultural Experiments with Vegetables

Both cane and velvet beans used as green manure increased the yield of a subsequent crop of potatoes at the Lower Valley station. At the Wichita Valley Station the use of either straw or nitrogen alone increased the yield of spinach. Both barnyard manure and green manure increased the yield of radishes. Friend and Pickett.

Cabbage and Related Plants

Cabbage Breeding: A number of duplicate lines were grown both at College Station and at Weslaco. Length, width, and core measurements were made on most matured heads in addition to securing weights. Cooperative work is being carried on with the Wisconsin Station to secure a uniform, round-headed, All Head Select line. Again winter selections sent to Wisconsin and also to Virginia failed to break dormancy and set seed.

Breeding Collards and Broccoli: Continued selections from inbred lines have been made and tested. Several of the collard lines not only are superior in coloring and petiole characters, but are very uniform.

Flory and Wood.

Cabbage Variety Test: Midseason Market, Marion Market, All Head Select, Round Dutch and Globe are listed in order of decreasing early yield as grown at Los Fresnos. For the whole season the order was Globe, Wisconsin All Seasons and All Head Select. Wood.

Onions

Breeding: Yellow Bermuda types flowered this season at the Winter Garden station. Over 1000 individual plant selections were made on the first year bulbs. These are sent to Beltsville, Maryland and to Davis, California, for seed increase. This work is in cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture. Hawthorn.

Culture: The fertilization of the seed bed has not increased the yield of onions in the field in 2 years out of 3. Yellow Bermuda onions sown September 5 had about half of the U. S. No. 1 bulbs of those sown two weeks later. Early Grano did better at the earlier sowing. Hawthorn.

Relation of Green and Dry Weights of English Peas: Preliminary work with 2 Creole and 3 F_3 (Thomas Laxton x Creole) lines in the greenhouse indicate that vine dried pods and peas have about 42 percent of the weight of the green mature form of this same material. Flory.

Irish Potato Variety and Cultural Studies

Of the new varieties Chippewa and Katahdin are well suited to planting in the Lower Rio Grande Valley section. Additional varieties and strains have been received from the U. S. Department of Agriculture for testing. It has been impossible to demonstrate an increase in yield due to complete fertilizer application in the area, although phosphate alone is beneficial. Friend and Wood.

Tomatoes

Adaptability and Breeding: At College Station the varieties are ranked according to the weight of marketable fruit for the first 3 spring harvests as follows: Stokesdale, Valiant, Rutgers, a Texas selection (L. 1359), Pan America, Firesteel, a Missouri selection, Master Marglobe, Bounty, Bonny Best, Wasatch Beauty and Marglobe. The Texas selection gave the heaviest total yield. At the Winter Garden station selections of a cross between Summerset and Bison have given excellent summer yields of large tomatoes (3 oz.). These have been crossed with Stokesdale. Additional work is in progress at the Lower Valley Station.
Yarnell, Hawthorn, and Wood.

Culture: Plants spaced 3x3 inches in the cold frame gave greatly increased early yields compared to plants left 12 or more per foot of seed bed row. Hawthorn.

Mineral Analysis of Turnip Greens

The work was limited to College Station this season where Golden Ball, Purple Top White Globe, Shogoin and Seven Tops were grown in triplicate randomized rows, half of which received a complete fertilizer. Yield of tops in the fertilized plats was excellent and about the same for Purple Top White Globe and Shogoin. Golden Ball yielded much

less, but still more than Seven Tops. This material was turned over to the divisions of Rural Home Research and Chemistry for drying and analysis. Yarnell.

Adaptability of Ornamentals

Recent aquisitions from the U.S.D.A. office of Foreign Plant Introduction that have done well at College Station include a species of Buddleia (P. I. 129197), two species of Spiraea (P. I. 102963 and 130392), *Eucalyptus exserta* (P. I. 90694 and *E. gunnii* (P. I. 124639), and a species of Rhamnus (P. I. 126394). *Albizzia kalkora, A. lebbek,* and *A. lophantha* have shown up well during one year in the nursery. Seedlings of *A. adinocephala, A. lebbekoides* are being placed in the nursery. *Juniperus pachyphloea* and *J. gymnocarpa,* after 3 years trial, appear well adapted to Central Texas. *Salvia coccinea* is a promising red-flowered perennial. Among the hybrid Daylilies *(Hemerocallis),* Margaret Perry, R 24-A, and Russel's U-3 have been outstanding for length of blooming period and for size and quality of the flowers. Additional information can be obtained from reports of many of the substations.

Yarnell, Denman, Flory, Pickett, Ratsek, and Substation Superintendents.

Oak Propagation

Grafting of the Ness Hybrid Oaks on various stocks was continued. Sixty-five percent of all whip, and 76 percent of all bark grafts were successful. Of all grafts on 8 species or forms of "white" oak 81 percent were successful. Only 22 percent of all grafts on 5 "black" oak species survived. Cleft grafts, probably due to difficulty of fit, were much less successful than bark and whip grafts. Flory and Brison.

Breeding Oaks and Other Ornamentals

The *Quercus virginiana* x *Q. lyrata* cross has been repeated, and 20 acorns were secured. Six selections of an open pollinated F_2 of this cross have been made. The cross *Q. virginiana* x *Q. serrata* was repeated for the third time; conditions were ideal; 1 small acorn resulted from 169 pollinations.

Four good plants from the 1938 cross of *Ilex vomitoria* x *I. decidua* are in the nursery. Most seed from the 1939 Ilex crosses still appear viable, but no seedlings have yet resulted. The cross *I. opaca* x *I. vomitoria* again yielded a large percentage of well-seeded fruits.

Five nice seedlings from the 1940 cross of Dallas Privet (Amor type) x Ligustrum sp. (lucidum type) are now ready for nursery placement.

The F_1 oleander hybrid has withstood temperatures of 19°F, without perceptible leaf injury, while the usual red oleanders have had their leaves and tips "burned." This hybrid has now flowered; it has pink, semi-double flowers, rather intermediate between the parental types.

Periwinkle *(Vinca rosea)*, pink x white flowers crosses, and the reciprocal, show pink to be dominant in the F_1. Presence of red pigment in the stem is correlated with presence of red in the flowers. Tetraploid lines have been initiated following colchicine treatment.

The three outstanding Hybrid Daylilies (Margaret Perry, R 24-A, and U-3) have been selfed and intercrossed to give over a hundred seedlings.

Flory.

Rose Investigations

Breeding for Improved Rootstocks: Over 2500 rose seedlings from previous crosses germinated at Substation No. 2, Tyler during the past season. In addition seeds were harvested from 68 crosses out of 217 attempted in 1941. Most of these crosses are interspecific. Selections of the older seedlings are under test in comparison with standard stocks. Ratsek.

Cultural and Storage Experiments: These include fertilizer and other tests at Substation No. 2, Tyler and No. 6, Denton. An account of this work can be found in the report of Substation No. 2. Ratsek.

Cytological Studies: Additional somatic chromosome counts have been made on material received under the following names: (diploid, 2x=14) *Rosa acanthoclada, R. blanda, R. coriifolia cinerea, R. ferox, R. glauca, R. Helenae, R. Jackii, R. moschata floribunda, R. pisocarpa,* and *R. Rouletti;* (tetraploid 2x=28) *R. caudata, R. foetida persica, R. gallica, R. lucida, R. lucida alba* and *R. Macounii,* and (pentaploid 2x=35) *R. baltica, R. canina montivaga, R. coriifolia, R. coriifolia Frobelii, R. cymosa, R. dumalis, R. dumetorum, R. lutetiana, R. mollis, R. rubiginosa.* The pentaploid species *R. banksiopsis* gives indication of 14 pairs plus 7 univalent chromosomes during the first meiotic division. All previous reports of meiosis in pentaploid roses and other species studied by us have 7 pairs plus 21 single chromosomes. This results in fewer microspores—from 5 to 8 instead of the 7 to 12 common among pentaploids. Yarnell and Blackhurst.

Herbarium Specimens: Antecedent to a taxonomical analysis of forms in the Station's rose collection, herbarium specimens of about 60 species and hybrids were prepared

Examination of Pollen: Pollen of 117 forms of 88 supposedly distinct species at Substation No. 2 and at the Main Station was examined. In diploids most froms have good pollen, in tetraploids the forms are rather evenly divided on the basis of poor, fair, and good pollen; while in both pentaploids and hexaploids the majority of observed forms have poor pollen, but a few members of each group have exeptionally good pollen. The two triploid forms had poor, the lone octoploid excellent, pollen. Pollen of 25 different hybrids was also studied. The same general tendencies noted in the different chromosomal groups of pure species were also noted in the hybrid groups. Triploids in general have less than 2 percent unaborted pollen; Silver Moon with about 12 and I.X.L. with about 28 percent apparently

good pollen are exceptions. Almost without exception a high correlation was observed between apparent pollen viability of the same forms in different years and at different locations. Flory.

Cytology Zephyrantheae

Our one plant of *Z. tubispatha* has 2n=25. Plants of *Z. carinata* have 48 chromosomes in contrast to 46 found in plants of this species by Nagao and Takusagawa. *Z. ajax* and *Z. macrosiphun* have 44 and 46 chromosomes respectively; 43 and 48 had earlier been given as approximate numbers for these. *Habranthus andersonianus* has 24 chromosomes; cytologically and taxonomically it appears identical with *H. andersonianus* var. *texanus*. *H. brachyandrous* has 24 chromosomes. First generation hybrids of *H. brachyandrous* x *H. robustus* (2n=12 have 18 chromosomes. Seeds of *H. brachyandrous* and its hybrid were supplied by Dr. H. P. Traub. Flory.

Fruit Investigations Laboratory, Montague

The Fruit Investigations Laboratory, two and one-half miles southwest of Montague and nine miles northeast of Bowie, Montague County. Latitude is 33 degrees and 40 minutes north; longitude 97 degrees and 45 minutes west; and elevation approximately 1166 feet above sea level. The rainfall has been very irregular for the three years in which records have been taken. Precipitation in inches has been 24.52, 46.42, and 54.31 for 1939, 1940 and 1941 respectively.

The Laboratory consists of 55 acres located in the grape growing district of North Texas. Most of the soil is typical of the fruit land in the northern portion of the West Cross Timbers.

The Laboratory was established in 1938 for the purpose of conducting investigations on problems of grape production, and to find ways of processing grapes to find a ready market. Subsequent work was added to conduct studies with tree fruits and berries; however, the chief concern remains with grapes.

Grape Investigations

Variety Test: The collection includes 346 lots mostly of American origin. Two hundred and twenty-five varieties are now in production. On account of an unusually heavy infection of black rot many varieties produced low yields. Even the Mustang and Dog Ridge were affected by this disease. Champanel, Ladano, James, Thomas and one plat of Carman were the only ones not affected with black rot. Sixty-nine varieties produced higher yields than Carman, the leading commercial variety. Etta produced the highest yield in the younger planting. While this variety yielded seven times more than Carman, the rate was only 4138 pounds per acre. Ladano was the heaviest producer this year. America was an outstanding variety in production, in value for making juice, and in resistance to black rot. The yield was second to highest 7260 pounds per acre, and the black rot infection was less than 14 percent. Other

high yielding varieties that showed considerable resistance to black rot in order of yield were Manito, Everbearing Cynthiana, Delaware, Husmann, Ben Hur, Edapa, Wapanuka, Headlight, Ives and Favorite. High yields were also obtained from Portland, Muench, Mericadel, Green Mountain and Agawam, but these were more susceptible to black rot. In addition to being good yielders, all of the above varieties had a reasonably low vine growth to yield ratio.

Fertilizer Test: Less difference in yield of the Carman grape was observed among fertilizer treatments this year probably because of weather conditions. Plats treated with fertilizer combinations containing phosphorus continued to be higher in yield but not so marked as before. Vine growth was also greater with plats receiving phosphorus. Best yield was obtained from an application of 6-12-6 at the rate of 900 pounds per acre. Fruit yields increased from 1365 to 2908 pounds per acre with increases from 0 to 900 pounds of 6-12-6. Vine growth was little affected by the increasing amounts of 6-12-6. Neither nitrogen alone, nor a treatment of nitrogen and potassium have been of value in increasing the yield over a period of two years. Nitrogen and potassium had some beneficial effect on vine growth. In contrast to a high ranking yield for the previous season, plats given barnyard manure at the rate of 8 tons per acre gave the lowest yield of any treatment. The greatest response from manure was in the development of vine growth as evidenced by the production of the largest amount of prunings. Size of trunk was less affected than was cane growth by fertilization. No increase in the sugar content of grapes was received from the use of fertilizers.

Pruning and Training Test: Grapes trained to the single-trunk four-cane Kniffin system produced higher yield because of more clusters than those trained to the Munson or modified renewal system. The yields from the latter two systems were about equal for the 1941 season while the average yield of the Muson exceeded that of the modified renewal over a period of two years. There was little difference in size of clusters among the three treatments. Less vine growth was observed with the Munson system, both in size of trunk and weight of prunings. The additional shade given the fruit by the canopy of the Munson system probably has no retarding effect on maturity since there was no difference in the sugar content of fruit from the training system.

Plantings with Reference to Terrace: Grapes planted above the terrace near the water channel failed to produce as satisfactory yield in 1941 as those on top of and below the terrace. The reduced productiveness of the vines in this location was probably the result of excessive moisture. The average yield *for two years*, however, is slightly higher from vines above terrance as compared with other plantings on or near the terrace. The lowest average yield has been obtained from plats between the terraces, while during the 1941 season these plats exceeded those above the terrace. The most vigorous vines are those on top of the terrace. All plats

on or near the terrace have produced more cane growth than those between terraces.

Elevation and Soil Type Plantings: This test consists of five plantings which represent three distinct elevations and variations in soil depth. Although in 1941 the hill-top planting with a medium soil depth yielded much less than a shallow soil planting on the side of a hill, the elevations appear to have less effect on the yield than the soil depth. Whether on the side of a hill or in the lowland, vines in the deeper soils were superior in yield with larger and more compact clusters. Average fruit yield for two years in pounds per acre is as follows: lowland (deep sandy loam) 4200, side of hill (deep blow sand) 4216, side of hill (deep fine sandy loam) 4058, side of hill (shallow sandy loam) 2550, and hill-top (medium depth sandy loam) 2452. In contrast to the fruit yield, the largest amount of vine growth has been obtained from the hill-top planting followed by vines on the side of hill (deep fine sandy loam), lowland, side of hill (deep blow sand), and side of hill (shallow sandy loam).

Spacing Test: The average yield in pounds per acre for two years has been 2471, 2073, and 1519 for 8 by 12, 10 by 12 and 12 by 12 spacings, respectively. Clusters were largest from the 8 by 12 and smallest from the 10 by 12. Vines have been more vigorous at the wider spacing, while slightly more pounds of prunings per acre have been pruned away from the narrow spacing.

Insect and Disease Control: The infestation of leafhoppers was exceptionally light during the 1941 season. This insect appeared in small numbers about the middle of June. One application of nicotine sulphate added to Bordeaux mixture was applied soon after the first appearance. Later in the season a few varieties were attacked by the leafhopper, but not until after the harvesting season.

The grape berry moth caused considerable damage in local vineyards. Only a few infested berries were observed in the station vineyard. The Marguerite variety was the only one to have a large number of infested berries. Lead arsenate was added to the Bordeaux spray application that was applied after the berries had set. Leaf-folder attacked the Elvicand, Champanel, Diana and Isabella varieties. This insect was held in check by spraying lead arsenate when the first signs of folded leaves were noticed.

Bordeaux mixture gave a better control of black rot than either dusting sulphur or wettable sulphur. There was only a minor difference in the effectiveness of the sulphur treatments. The sulphur fungicides injured the foliage causing considerable defoliation by the end of the growing season and also seemed to have some retarding effect on the development of the clusters as was evidenced by smaller and more open clusters. Average yield of Carman in pounds per acre for two years has been Bordeaux 1889, wettable sulphur 1286, and sulphur dust 1186.

Cover Crop Test: There is no indication that green manure added to the soil has increased the yield of grapes during the past two years. Plats without cover crops have yielded higher than those receiving Austrian winter peas and hairy vetch and have almost equalled the yield received from those that were planted to a small grain mixture of oats, wheat and barley. Vines have been more vigorous where no cover crop was used. A very good cover was obtained from the small grain crop, while only a fair growth was made by the Austrian winter peas and hairy vetch.

Rootstock Test: A vineyard planting was made in 1940 of Carman, Virginia and Delaware varieties grafted on Dog Ridge, Champanel, La Pryor and a local species. It is surprising to note that in 1941 all of the stocks increased the vine growth of the Carman, a very vigorous variety. The effect of La Pryor on the growth of Delaware a weak variety, was slightly above that on Carman. Two stocks failed to stimulate the vigor of Delaware—Dog Ridge and Champanel. The native species was the only stock that did not increase the growth of Virginia, a variety of medium vigor. Delaware made more cane growth on La Pryor; Carman and Virginia made more cane growth on Champanel.

Propagation Test: The propagation test was begun in 1939. La Pryor used as a rootstock for Delaware, Carman and Virginia has given the highest percentage 32 of successful graft unions. Other stocks used with the same varieties were Champanel 30%, Dog Ridge 23%, and a local species 23%. Varieties have varied in congeniality with different stocks. Delaware and Virginia have united best with La Pryor; Carman has united best with Champanel. Grafts callused in a heeling trench prior to planting have united better than those planted direct in the nursery. Neither Hormodin "A" in 20 B.T.I. units, or Auxilin in .004 percent concentration stimulated rooting of grafts. Treating top of scions with paraffin did not increase the number of rooted grafts.

Cuttings planted direct in the nursery have rooted as successfully as those callused befor planting. Hormodin "A" in 40 B.T.I. units gave 56 percent rooting. Other treatments tried were Auxilin in .004 and .006 percent concentration 54 percent each, Hormodin "A" in 20 B.T.I. units 52 percent, no treatment 48 percent, and tops of cuttings coated with paraffin 42 percent. Cuttings cut at the center of the internode at both ends were 24 percent successful and those cut at center of internode at bottom and just above top gave 76 percent of rooted plants. Very small difference has been observed in the number of rooted cuttings between those cut just above top node and those having one-fourth of the top internode left, while there has been a marked decrease in rooted plants where one-half of the top internode was left irrespective of the cut at the bottom.

Products Test: Bulk-pasteurized juice and fresh grapes were shipped to Substation No. 3 for product studies. In addition, juice samples of

most of the fruiting varieties were sent for analysis. The investigations with grape products are included in the report of Substation No. 3.

Tree Fruit Investigations

Variety Test: A variety planting was made in 1940 consisting of three plants each of 45 varieties of peaches, 15 of plums, 8 of apples, 5 of pears, and one variety of apricot. This planting is not of bearing age. Most of the plants have made excellent growth.

Cultural Test: Plantings of the Elberta peach were made in 1940 for a test of fertilizers and cover crops. The trunk growth has not been influenced by applications of nitrogen and 6-12-6 fertilizers, or through turning under small grain cover crops. Neither does the top growth appear to have been affected by these treatments.

Blackberry and Dewberry Varieties: Highest yielding berry variety during the second season was the Dew-Black. Yields in pounds per acre were as follows: Dew-Black 2555, Boysen 2107; Austin 1792, McDonald 1725, Young 1377, and Dallas 1261.

Ornamentals

New kinds of ornamentals added to the landscape plantings, composed exclusively of species native to Texas, were *Berberis Swazeyi* (Blue Agarita), *Callicarpa americana* (French Mulberry) *Crataegus* sp. (Red Haw), *Eupatorium havanense Lantana camara*, *Salvia farinacea* (Mealy Blue Sage), *Anisacanthus Wrightii*, *Sophora secundiflora* (Mescale Bean), *Dasylirion texanum* (Sotol), *Salvia azurea* (Giant Blue Sage), and *Prunus texana*. The *Leucophyllum texanum* (Cenizo) went through the mild winter without any setback. This plant produced an abundance of blossoms during the summer and early fall. *Salvia regla* failed to bloom as profusely as in previous years.

Randolph.

Sweet Potato Investigations Laboratory, Gilmer

This Laboratory, containing 117 acres, was established in 1938 to investigate problems affecting yield and quality of sweet potatoes. The average yield for Texas for the period 1928-1937 was 73 bushels per acre. The average yield from all experimental plats at the laboratory for the four-year period, 1938-1941, was 210 bushels. Demonstration of proper seed selection and treatment, and assistance to cooperating agencies disseminating this information, have enable most growers in the area to secure higher yields as well as a higher price on the northern markets.

Excessive rainfall during the 1941 growing season caused severe erosion and soil packing in the experimental plats, thus damaging stands and yield data, and resulting in poor yields consisting largely of low grade roots. A total of 55.13 inches of rainfall was recorded for the season, 14.88 inches of which fell during June.

Fertilizer Test

Response to the different rates and analyses of fertilizer was somewhat different from the three previous seasons, due in all probability to the heavy rainfall during the growing season. A 600-pound application of 4-12-4 produced 227 bushels per acre, and one of 4-12-8 applied at the same rate produced 245 bushels. The unfertilized check plot made a total yield of 18 bushels, 67 percent of which were culls. Increase in yields was fairly consistant as the rate of application of nitrogen, phosphorus, and potash was increased. Based on a four-year average, the following treatments were significantly better than the mean yield for the 16 fertilizer treatments: 4-12-4, 4-12-6, 4-12-8 and 6-12-4, all at the rate of 600 pounds per acre.

Time of Application of Fertilizer

There was no significant difference in yield, during the three-year period, between 600 pounds applied before planting and a split application of 300 pounds applied before planting and 300 pounds as a side dressing. Plots receiving all the fertilizer before planting grew off better and required less cultivation. This indicates that the most economical procedure would be to apply all the fertilizer before planting when the rate of application does not exceed 600 pounds per acre.

Dates of Planting and Differential Spacings

This is a cooperative test with the U. S. D. A. Bureau of Plant Industry. The Porto Rico and Triumph, edible and starch varieties, were planted at five dates during the period April 25 to June 24, with seven spacings ranging from 9 to 42 inches for each variety in each planting date. Yields from the first three dates of planting were significantly higher than the last two. Fifteen to 18-inch spacings were most profitable, and these spacings are commonly used in this section. The average yield for Porto Rico was 258 bushels as compared with 254 for Triumph.

Height of Beds

A test containing five ridge heights, each being maintained throughout the growing season, has been conducted for a period of four years. The highest yield and highest percentage of marketable sweet potatoes was obtained from the six-inch ridge height. A six-inch ridge is easily prepared and cultivated with ordinary farm equipment.

Dates of Harvesting

The dates of harvest studies were combined with a cooperative test with the U. S. D. A., Bureau of Plant Industry, to study the combined effect of height of ridge, rates of application of nitrogen, and dates of harvesting on yield, color, storage qualities and plant production of Porto Rico sweet potatoes. Significant differences in yield were noted

for the four harvest dates, with yields increasing until the vines were killed by frost. Early harvested sweet potatoes continued to produce the earliest slips, as well as more slips per bushel of seed stock.

Cover Crop Test

Sweet potatoes were planted the third year on the same plots following oats, vetch and check plots, half of which were unfertilized and half received 600 pounds of 4-12-4 per acre. The fertilized plot without a cover crop produced the highest yield during 1941, and has the highest average for the three-year period.

Due to an accumulation of diseases in the soil, over fifty percent of the crop was unsuitable for storage, demonstrating the fact that sweet potatoes can not be successfully grown without proper rotation. For this reason it was necessary to abandon the test at the end of the 1941 season.

Comparison of Rooted and Cut Slips

In a comparative test, fertilized with 600 pounds of 4-8-10 per acre, rooted slips made a total yield of 228 bushels compared with 146 bushels for the cut slips. Rooted plants grew better immediately after setting than the cut slips. The three-year average for the cut slips is 150 bushels, and 164 bushels for rooted slips.

Cultural Test

No significant difference in yield was noted when sweet potatoes were laid by at the following stages of growth: (1) bunched for running, (2) runners 6 inches long, (3) runners 12 inches long, (4) runners lapping in middles, and (5) two weeks after No. 4. These results follow those obtained during the 1940 season, and indicate that such cultivation as is required to keep down weeds and grass is sufficient for sweet potatoes when the ground is thoroughly prepared before planting.

Variety Adaptability Studies

A U. S. D. A. seedling, B-196, produced the highest total yield of sweet potatoes, 471 bushels per acre, with an average starch content of 23.02 percent, and the highest estimated yield of starch on an acre basis, 5,963 pounds. Triumph, the standard commercial starch variety, produced 221 bushels, with a starch content of 21.28 percent, and an estimated starch yield of 2,580 pounds. Starch varieties adapted to other areas have not produced satisfactorily under East Texas conditions.

The Texas Porto Rico, a station selection, made a yield of 334 bushels per acre compared with 216 for the Porto Rico. The station selection has a more uniform and richer yellow flesh color indicating a higher vitamin and sugar content.

Two of the Jersey types which usually bring a premium on the northern markets made the following yields: Big stem Jersey, 113 bushels, and Maryland Golden, 87 bushels.

Poor germination in the lot of 3000 seed produced during the 1940 season resulted in only 1000 seedlings. Some 30 selections were made from this material for further testing. Ninety-three lots of sweet potatoes set seed this season, with a total harvest of 5,652 seed.

MAIN STATION AGRONOMY FARM

The Main Station Agronomy Farm is located on the land of the Agricultural and Mechanical College of Texas at College Station, Brazos County. The Station comprises 101 acres of land, 76 acres of which are used for experimental purposes and the remaining acreage for buildings, pastures, and roadways, and for the production of seed of superior strains of crops on the farm for distribution to farmers. A large percentage of the land is made up of Lufkin fine sandy loam soil.

Rotation and Soil Improvement Investigations

During the 28 years (1914-41) those plats receiving manure either alone or in combination with superphosphate or rock phosphate have made the greatest yields. The treatment of manure alone produced 240 pounds of lint cotton to the acre, manure and rock phosphate produced 212 pounds of lint cotton to the acre, and manure and superphosphate produced 212 pounds of lint cotton to the acre. For the same period of years, the average of three plats which received no treatment was 174 pounds of lint cotton to the acre, or 66 pounds per acre less than the highest yielding treatment.

Cotton: For the 15-year period, (1927-41), the three highest yielding treatments are as follows: 12 tons of manure and 400 pounds of superphosphate gave a yield of 360 pounds of lint cotton to the acre; 12 tons of manure gave a yield of 340 pounds and 8 tons of manure gave a yield of 321 pounds. The average yield of the 5 check plats which received an application of 400 pounds of 4-12-4 commercial fertilizer to the acre was 295 pounds of lint cotton to the acre. The untreated plat for the same period of years produced a yield of 206 pounds of lint cotton to the acre or 154 pounds less than the highest yielding treatment. This figure is quite significant in favor of fertilizer.

Corn: For the same 15-year period the 3 treatments producing the greatest yields are as follows: 12 tons of manure and 400 pounds of superphosphate per acre gave a yield of 34.1 bushels of shelled corn per acre; 12 tons of manure gave a yield of 32.6 bushels; and 8 tons of manure and 800 pounds of 4-12-4 commercial fertilizer each gave a yield of 31.3 bushels. The average yield of the 5 check plats was 28.6 bushels, while the plat which received no treatment produced only 23.4

bushels, which is 10.7 bushels per acre less than the highest yielding treatment.

Oats: For the same period of years the following are the treatments producing the greatest yields: 800 pounds of 4-12-4 commercial fertilizer per acre gave a yield of 37.4 bushels of grain per acre; 600 pounds of 4-12-4 commercial fertilizer per acre gave a yield of 34.8 bushels and 800 pounds of 8-12-8 commercial fertilizer per acre gave a yield of 34.3 bushels. The plat which received no treatment produced only 23.4 bushels, or 14.0 bushels less than the highest yielding treatment. This figure is also quite significant in favor of fertilizer. The average of the 5 check plats which received 400 pounds of 4-12-4 commercial fertilizer to the acre was 30.3 bushels.

Cotton Variety Test

On the basis of comparable yields among those varieties that have been grown for 10 years or longer, the highest yielding varieties are: Ferguson 406, 241 pounds of lint cotton to the acre; Sunshine, 238 pounds; and New Boykin, 230 pounds. Several varieties which have been in the test for only the past two or three years are showing a great deal of promise, but further testing will be necessary before those varieties can be compared with other proven varieties. Among those varieties that have been grown for the last two or three years, D. & P. L. 44-51, stoneville 2B, and Sunshine 74-2 have shown a great deal of promise. It so happens that D. & P. L. 44-51 has also shown a great deal of promise in the tests conducted on the Brazos River Field Laboratory.

Green Manure Test

For the 5-year period (1937-41) the average yield of those plats planted to vetch and receiving an application of 500 pounds of 4-8-4 commercial fertilizer to the acre was 307 pounds of lint cotton to the acre, while the average of those plats planted to vetch and receiving an application of 500 pounds of 0-8-4 commercial fertilizer to the acre was 301 pounds of lint cotton to the acre.

Although the yields in 1941 causes a slight change in yields per acre in favor of those plats having vetch and receiving applications of 500 pounds of 4-8-4 commercial fertilizer to the acre, there are still indications that a good growth of vetch will furnish as much nitrogen to the soil as the succeeding cotton crop can use.

Increase of Pure Seed

Increased planting of pure seed consisted of MacSpan peanuts, Surchopper Sugar seed corn, and Ranger oats. A limited quantity of Ranger oats has been distributed to farmers and a sizebale quantity will be available for 1942 fall planting. This variety has shown a great deal of re-

sistance to rust and smut and has been found to be well adapted to the coastal region of East Texas.

Texas Hybrid No. 10 seed corn was produced on the station and the entire supply of seed has been sold to farmers in the state. This corn was produced by using Yellow Surcropper as the seed parent and the single cross, (132A x 173D) as the pollinator.

Two white single crosses of corn were made (4R-3 x 61M) and (158-4 x 102A). All of this seed has been sold to seedsmen within the state for the production of commercial hybrids in 1942. Roberts.

Brazos River Field Laboratory

The Brazos River Field Laboratory comprises 215 acres in the flood plain, or first bottom, of Brazos River. The farm is located ½ mile south of Jones Bridge, in Burleson County, and is seven miles southwest of College Station, Texas. The station serves primarily as a place for agronomic studies under conditions representative of the fertile valleys along streams in East Texas, such as are particularly extensive along the Brazos and Colorado Rivers.

The principal soils of the station are the Miller clay; Miller silty clay loam; Yahola clay, deep phase; and yahola clay. These are very fertile reddish-brown calcareous alluvial soils. The two series have similar surface soils, but differ in their subsoils, which are heavy in the Miller and sandy in the Yahola.

Corn Varieties and Hybrid Yield Test

This test is designed primarily to compare Texas hybrids and out-of-state hybrids with several commercial varieties used as standards. The standard varieties are grown each year and are used as a basis for comparison with other varieties.

In 1941 the average yield of the standard varieties was 35.4 bushels of shelled corn to the acre. The best Texas hybrid, No. 12, produced 41.6 bushels of shelled corn to the acre, and Texas hybrid No. 6 produced 40.9 bushels of shelled corn to the acre. Among the out-of-state hybrids, Iowealth-31 produced the highest yield, 44.2 bushels of shelled corn to the acre, and Iowealth-Tx3 was second with a yield of 42.2 bushels of shelled corn to the acre.

Figures on ear worm damage show that open pollinated varieties are more resistant to damage than either group of hybrids, although the Texas hybrid on the whole is more resistant than the out-of-state hybrids.

Cotton Investigations

Tests in the control of the cotton boll weevil, the boll worm, and varietal resistance to insects, conducted on the Brazos River Field Lab-

oratory under the supervision of the division of Entomology are reported under that division.

Tests in the development of new varieties of cotton, cytogenetic and improvement tests, and tests of efficiency of distribution and placement of cotton seed and fertilizer, conducted on the Brazos River Field Laboratory are reported under the Divisions of Agronomy and Agricultural Engineering.

Increase of Pure Seed

Stoneville 2-B cottonseed, a variety which has shown considerable promise on the Brazos River Soils, was increased on this station. There has been a ready demand for this seed, and distribution will probably be confined to areas in the general locality of the station.

Texas hybrid No. 14 seed corn was produced on the station and the entire supply of this seed has been sold to farmers within the state. This hybrid is a double cross and was produced by using the single cross (132A x 173D) as the seed parent and the single cross (KYS x 38-11) as the pollinator. The first single cross (132A x 173D) is a single cross produced by two Texas inbred strains, while the KYS came from Kansas, and the 38-11 came from Indiana. Roberts.

PLANT PATHOLOGY AND PHYSIOLOGY

Cotton Root-Rot Investigations

(Including cooperative work with the Bureau of Plant Industry, U. S. Department of Agriculture)

Cotton root rot and the weather. In the study of the relation of weather to cotton root rot, caused by the fungus *Phymatotrichum omnivorum*, data were obtained on the way losses correctly attributable to root rot may be masked in average figures. The same increase in rainfall that encourages spread of root rot aids also growth of the cotton plants that are not attacked. Yield data made up by averaging yields from fields in which root rot occurs with yields from other fields in the same area in which there is little root rot can therefore conceal in the average the loss that is being caused by the disease. Disastrous losses from root rot thus may not show from simple comparison of average yields and average prevalence. Several lines of work have instead furnished a basis for estimating percentage reduction in yield as approximating nine-tenths the percentage of plants killed by date of first picking.

Attenuation of cultures of the root-rot fungus by repeated transfer of young mycelium. In continuation of work on variation within the fungus *(P. omnivorum)*, it has been discovered that sucessive transfer from young cultures results in a remarkable cumulative attenuation of the transplant. Transfers made weekly from peripheral portions of plate cultures have become attenuated more rapidly than transfers made

weekly from proximal discs, which in turn declined in rate of growth more rapidly than transfers made at 3-week intervals. Preliminary experiments indicate that the immediate cause of the attenuation is probably neither accumulation in attenuated cultures of diffusible inhibitory materials (as a phage) nor lack of growth-promoting materials as yet tested.

Resistance tests of seedling trees. One-year-old seedling trees were tested at Bryan, where previous severe root rot and suitable weather conditions favored attack by root rot during 1941. Half of the Russian olive and Chinese elm seedlings were killed by root rot, only 1 of 8 slash pines, and none among 6 small red cedars and 3 seedling mimosas.

Greenhouse tests were made of 9 seedlings each of several species of Albizzia. Five plants of *A. lophantha* succumbed, 1 of *A. kalkora*, 1 of *A. lebbek*, and none of *A. julibrissin*. Under the same conditions, 8 of 9 plants of *Sophora secundiflora* were killed. These greenhouse inoculations add to the list of plants which the root-rot fungus may attack, *Albizzia lophantha, kalkora*, and *lebbek*. The continued resistance of *A. julibrissin* suggests that the mimosa (silk tree) can be added to the small list of trees for root-rot areas. Ezekiel.

Root-rot test nursery at the Temple substation. Critical tests of the susceptibility of many species of plants to root rot have been continued in root-rot test nurseries at several locations. During 1941, relatively small percentages of root rot were recorded in the Temple planting. One-year-old seedlings of *Ulmus pumila* showed only 38 percent loss, *Elaeagnus angustifolia* 14 percent root rot, *Pinus echinata* 6 percent, and many other species of root rot. One plant of *Dalea argyraea* succumbed to root rot, making the first record of the disease on this species. Some older plants of *Abelia grandiflora, sophora secundiflora, Leucophyllum texanum*, and *Baccharis neglecta* were attacked, indicating that with the Baccharis as well as the other plants, there is continued susceptibility at even established plants and that a moderately susceptible rating (at least "††" is justified). Ezekiel and Rogers.

Some organic acids as growth-promoting materials for the root-rot fungus. In continued studies in cooperation with the Division of Chemistry, addition of gallium at 0.25 to 25.0 p.p.m. to nutrient solutions caused no increase in growth of *P. omnivorum*. No consistent increase was obtained with additions of a number of organic compounds. However, succinic, fumaric, citric, and stearic acids, and mixtures of these acids, added at 1, 10, or 100 p.p.m, caused consistent increase in the oven dry weight of the fungous mats. Ezekiel and Simpson.

Methods for eradication of root rot in nurseries and orchards in deep sandy soil. (In cooperation with the Texas Forest Service.) The major line of attack in the work started at the Indian Mound Forest Nursery, near Alto, is by acidification of the soil with sulphur. During the

winter of 1940-41, a plot experiment was set up with initial applications of up to 1500 pounds of sulphur per acre. During 1941, the lower rates of treatment did not consistently reduce the percentage of cotton plants killed by root rot, while there was effective reduction with the higher rates. The results for the first year of this experiment thus confirm our previous findings, that prevalence of root rot can in general be reduced by application of sulphur in soils not too highly buffered. With the further additions of sulphur in certain plots some evidence should be obtained within the next few years as to whether the root-rot disease can actually be elimimated from an infested area by sulphur applications.

For eradication of root rot when it occurs only in a definite small area, some method for rapid chemical treatment of the soil would be desirable. As a supplement to the sulphur experiments, some plots were treated with chloropicrin and some with industrial xylol. The plantings on these plots for 1941 were delayed and no root rot occurred even in the check, untreated plots. Ezekiel and Nelson.

Winter cover crops in relation to root rot. Experiments to determine the value of winter grown legumes in root-rot control were initiated in October, 1940. Hubam clover *(Melilotus alba* var. *annua)* and sour clover *(Melilotus indica)* were planted on root-rot infested soil in Washington county. The sour clover had made a top growth of approximately ten to twelve inches when turned under in mid-March. The growth of Hubam was considerably less. Cotton was planted on these plots in mid-April. Only a light development of root rot occurred in the experimental plot and no conclusions are possible. Additional legumes were included in the plantings made in October, 1941, in Washington and in Burleson counties.

Tillage and fertilizer experiment. The effect of various methods of preparation of the land and of the addition of nitrogen fertilizer upon the occurrence of root rot on cotton was studied in an experiment on root-rot infested soil in Washington county. The operations incident to flat breaking, ripping out of stalks, and application of fertilizer were accomplished in September, immediately after harvest of the preceding crop. All treatments were bedded and rebedded during the latter part the winter. The greatest reduction in the amount of disease and increases in yield occurred on the plots that were both flat-broken and fertilized. The response to flat-breaking alone was less pronounced. There was little or no effect apparent due to ripping out of stalks or nitrogen fertilizer applied in the fall as compared with ordinary late bedding. Blank.

The relationship between pH and the inorganic sources of nitrogen in fungous culture. Experiments attempting to buffer the nutrient solutions over a wide pH range so as to permit a more accurate evaluation of the influence of pH on the reaction of *P. omnivorum* to nitrate and ammonium nitrogen have been only partially successful since the tendency

to develop an acid reaction with ammonium nitrogen and a basic reaction with nitrate nitrogen has prevailed whenever good growth was obtained.

Growth reactions to amino nitrogens. Experiments evaluating the ability of the root-rot fungus to use single amino acids or closely related organic nitrogenous compounds have shown that arginine, alanine, asparagine, aspartic acid, glutamic acid, glycine, proline, and tyrosine were good sources of nitrogen, while fair growth was obtained from cystine, leucine, iso-leucine, methionine, phenylalanine, and valine. Glycine anhydride, histidine, lysine, and tryptophan were poor sources of nitrogen. Nitrogen in certain organic forms is relatively unavailable.

Absorption and utilization of inorganic nitrogen. Studies were conducted to determine the rate and amount of the absorption of nitrogen by *P. omnivorum* from nutrient solutions with nitrogen derived from ammonium nitrate, a combination of nitrate salts, and a combination of ammonium salts. Analyses showing the amount of nitrate, nitrite, amino, and of basic nitrogen in the external solution and in the fungal mat were made after 6, 12, 18, and 24 days growth. There was no substantial difference in the absorption of nitrogen from the different sources studied. Growth and nitrogen absorption were found to be parallel. The nitrogen content of the nutrient solution decreased as growth occurred. There was an increase in the relative content of nitrogen in the fungus as growth proceeded. Nitrate nitrogen was not found to accumulate in the fungus. No nitrite nitrogen was found either in the external solution or in the fungal mat.

The absorption and utilization of organic nitrogen. Studies similar to those conducted on the inorganic sources of nitrogen were conducted on the amino acids mentioned above. Analyses were made only after 20 days growth in the nutrient solution. Nitrogen absorption and growth were found to be parallel. The decrease of nitrogen in the external solution was found to be dependent on the amount of growth that had occurred. Talley, Mason, and Blank.

Physiology of the cotton plant and susceptibility to root rot. The susceptibility of cotton plants to *P. omnivorum* has been found to be related to the carbohydrate levels in the root bark. Fruitful, high-nitrogen plants, with low concentrations of carbohydrates died within 10 days after inoculation, whereas low-nitrogen defruited plants high in carbohydrates remained alive indefinitely. Similar results were obtained in both field and greenhouse experiments.

In a factorial-design field experiment conducted on Houston soil, fall plowing reduced the percentage of dead plants (August 15) from 39.0 to 25.3 percent and increased the yield by 36 percent. The addition of 120 pounds of nitrogen in the fall was without effect on root rot but increased yields by 14 percent. Spacing 2 plants every 28 inches in

the row versus 2 plants every 14 inches reduced root rot slightly and increased yields slightly.

Antagonistic action by other soil borne fungi against *P. omnivorum* was observed when milo seed infected with *P. omnivorum* were placed on petri dishes containing Miller, acid Wilson, and acidified Lufkin soils. These soils are characteristically free from root rot. Three of these fungi *(Trichoderma* sp., *Rhizopus* sp., and *Fusarium* sp.) were isolated and placed in hills with cotton seed at time of planting but no evidence of protection against root rot was obtained.

A method of inoculating plants with *P. omnivorum* that is capable of standardization and possessing some experimental advantages has been developed. Milo seed are autoclaved and then inoculated by spreading on plates of *P. omnivorum.* Given numbers of these infected seed are placed at uniform depths about 1 inch from the tap root of the plant. The number of days from inoculation to death provides a measure of resistance.

Eaton and Rigler.

Artificial inoculation of cotton plants grown under various nutrient conditions. Mature cotton plants that had been grown on widely different nutrient solutions in sand culture were inoculated with the cotton root-rot fungus in the manner reported last year. Eight different solutions were used including all possible combinations of high and low levels of nitrogen, phosphorus, and potassium. Plants from all of the nutrient solution groups reached the permanently-wilted stage only a few days apart. Dunlap.

Other work on cotton root rot is reported under Substation No. 5, Temple; Substation No. 16, Iowa Park; and Substation No. 15, Weslaco.

Cotton fruiting studies

Acala cotton plants have been grown in the greenhouse and out of doors both in containers of soil and in jars of washed river sand with added nutrient solution. Under all of these conditions marked increases in individual plant yields and improvement in the percentage of squares forming mature bolls have heen obtained with the higher levels of nitrogen. Differences in yield due to variations in the amount of phosphorus or potassium supplied were relatively slight as compared with variations in amount of supplied nitrogen. Periodical wilting of plants in soil has resulted in smaller plants and a marked reduction in number of mature bolls per plant. In sand culture, where rapid wilting for short periods was possible, the reduction in amount of fruiting was not as great as in the case of soil plants. With out-of-door plants in the summer and greenhouse plants in the fall series, temporary shading of plants with black cloth, for one or a few days at a time, resulted in greatly increased amount of shedding and in 50 percent or more reduction in yield. Certain varietal differences in fruiting capacities and shedding were indicated. Dunlap.

Tomato Diseases Laboratory, Yoakum

Tomato wilt. Excessive rains during the spring growing season prevented reliable field observations on the wilt-resistant hybrids. However, 247 lines were tested in the greenhouse for resistance to *Fusarium lycopersici* by the nutrient-liquid-culture technique. Approximately 500 plants from lines that failed to show any symptoms of wilt were grown to maturity during the summer and fall months. Selections were made from these plants for field trials in 1942. Several of the lines are practically immune to wilt and have large globe-shaped fruits of commercial type. These strains appear also to be more resistant to stem cracking than either Marglobe or Rutgers, the two standard varieties in the Yoakum-Hallettsville area.

Spraying of tomatoes for disease control. No field tests were conducted in 1941 on the spraying of tomatoes because of field conditions. However, several tests were conducted in the greenhouse where young tomato plants were sprayed with different fungicides and then inoculated with spores of *Alternaria solani*. No fungicide gave complete protection, however, several gave fairly good control. Sprays containing copper oxychloride, copper oxychloride sulphate, tri-basic copper sulphate, and yellow copper oxide gave nearly as good control as the standard Bordeaux mixture.

Early blight. A number of tomatoes were tested for resistance to *Alternaria solani* by immersing young 6-8-week old plants in a suspension of spores and then placing the plants in a moist chamber for periods of 24 to 60 hours. All varieties of *Lycopersicon esculentum* proved very susceptible, while certain strains of *L. pimpinellifolium*, *L. peruvianum*, and F_1 hybrids of *L. esculentum* x *L. hirsutum* had more resistance to the early blight fungus than any other tomato in these tests. However, all attempts to cross this tomato on to *L. esculentum*, varieties Rutgers, Golden Dawn, John Baer, Riverside and Pearson, *L. glandulosum* and *L. hirsutum* met with failure. Good fruits were produced in a number of cases, but no viable seeds were produced. Application of indoleacetic acid as a paste to the stigmas and inmmersion of the plants several days before blooming in a solution of colchicine were of no benefit in making difficult interspecific crosses. A few attempts have been made to cross *L. peruvianum* and *L. glandulosum* with *L. esculentum*, but no viable seeds have been produced.

Grey spot. Grey spot *(Stemphyllium solani)* was found to be prevalent in August and September on some summer tomatoes. This is believed to be the first report of this disease in Texas.

Nematode root knot. A number of tomatoes were grown in soil infested with *Heterodera marioni* and later examined for root knot. The roots on all varieties of *L. esculentum* were covered with root-knot galls, while several strains of *L. peruvianum* and *L. peruvianum* var. *humifusum* had either no galls or only a few inconspicuous ones.

Rosette of tomatoes. A disease that had been observed on a few plants in 1939 and 1940 and that closely resembled the published description of bunchy top was widespread and very destructive to the fall tomato crop in 1941. All attempts to transmit the disease by grafting and by leaf rubbing have failed. The cause of the disease is unknown. Since the disease differs in several respects from bunchy tops, the name rosette, which describes it aptly, is given to this new trouble.

Seed treatment. The cooperative seed treatment experiment sponsored by the committee for Coordination in Cereal and Vegetable Treatment Research of the American Phytopathological Society was carried on again this year with beets, cucumbers, peas, and spinach. Significant increases in stand were obtained by treating cucumber seed with Semesan or red copper oxide and beet seed with zinc oxide. No significant increase in stand was obtained by treating pea seed with Semesan, red copper oxide, or Spergon, nor did seed treatment with zinc oxide or red copper oxide improve the stand of spinach. Harrison.

Greenhouse studies of wilt resistance. During 1941, a number of selections, hybrids, and imported varieties of tomato were tested for resistance to Fusarium wilt by the sand culture method. Plants grown from seed obtained from highly resistant selfed F_2 hybrids continued to be highly resistant.

Root-knot and wilt resistance in tomatoes. Tests designed to indicate the effect of nematode root knot on the susceptibilty of different tomato varieties to Fusarium wilt have not yet been conclusive. The method developed for obtaining root-knot infected plants by spraying the suspension of larvae and eggs of the nematode over the sown flat has been used. This insures a more even distribution of the nematodes and consequently, a more uniform plant infection.

While no nematode-immune tomato variety is known, there seems to be a difference in the resistance of certain varieties. Some of the most severely infested varieties include Bonny Best, Grothen's Globe, Louisiana, Dixie, and Marhio. Those suffering medium infestation include Bison, Break O'Day, Buckeye State, Essar, Glovel, Illinois, Baltimore Louisiana Pink, Pearson, Riverside, and Rutgers. Pritchard was found to suffer but slight infestation. Of 6 varieties brought into the United States by plant explorers. P. I. 140406 and P. I. 140413 were severely infested. P. I. 140403 and 140410 suffered medium infestation and P. I. 140404 and P. I. 140405 were but slightly infested. Altstatt.

Report of work at Stockdale

Peanut diseases. Dusting of peanuts with sulphur appeared to reduce damage from Cercospora leaf-spot, but the disease did comparatively little damage and no significant differences in yield were obtained. Treatment of both shelled and unshelled peanut seed with 5 percent

ethyl mercury phosphate and red copper oxide had no effect on stand or yield in any of four trials. Various fungicides, fertilizers, and other materials employed as soil treatments alone and in various combinations had no effect on incidence or severity of southern blight of peanuts at the rates employed on heavily infested soil under conditions favoring the disease. One hundred twenty lots of peanut seed representing different varieties strains, and selections, and also 100 single-plant selections were tested for disease resistance, with several dates of planting, on two fields with excellent results. Selections were made for resistance to southern blight and to Cercospora leaf spot for use in the breeding program.

Watermelon diseases. All of the Fusarium-wilt-resistant watermelon lines tested gave satisfactory stands on land where a loss of 85 percent of the plants occurred with the susceptible Kleckley Sweet variety. Several hundred single-hill plantings of watermelon seed lots from the U. S. Bureau of Plant Introduction were made. There appeared to be considerable variation in susceptibility to anthrocnose although all of the strains were seriously affected by this disease.

Cantaloupe spraying and dusting studies. As a result of excessive precipitation during May and early June, fungicidal sprays and dusts failed to give satisfactory control of downy mildew at Stockdale. Copper oxychloride dust was far superior to other materials tested in keeping leaves green, with home-made Bordeaux mixture second best, and yellow copper oxide spray, and red copper oxide dust following in order.

KenKnight.

Four applications of a spray containing copper oxychloride and wheat flour (3-3-100) resulted in a marked increase in the yield of cantaloupes during a severe epiphytotic of downy mildew *(peronoplasmopara cubensis)* at the Tomato Disease Laboratory, Yoakum. Somewhat smaller yields were obtained with Bordeaux mixture 8-8-100 and with tri-basic copper sulphate as a dust. Red copper oxide as a spray gave only slight increases in yield, while as a dust it caused a decrease in yield.

KenKnight and Harrison.

Garlic and onion diseases

Garlic disease studies. The yield of garlic in the 1941 experimental plots at Moulton was the highest obtained since the work was initiated in 1936. Seed-piece selection and favorable growing conditions probably resulted in the increased yield. The total yield of green garlic was about 6,000 pounds on 2½ acres. The best row yield were made from seed pieces (cloves) selected from disease-free bulbs of the previous crop. Fields from unselected seed pieces which were treated with various fungicides were not as large as those obtained from the untreated, carefully-selected seed pieces. The percentage of U. S. No. 1 bulbs was much higher in 1941 than in 1940. Seventy-six percent of

the current crop of bulbs were of U. S. No. 1 size, as compared to only 41.5 percent last season. Only 13.6 percent of the bulbs graded U. S. No. 2 this year as compared with 45.1 percent for 1940.

Garlic cured on chicken wire shelves in a roofed open shed had less shrinkage and spoilage subsequently than garlic artificially cured by forced warm air and also less than garlic cured in the field without special protection or facility of drying.

Garlic affected with a disease causing a mosaic or streaked pattern in the leaf yielded 60 percent as much as healthy plants. An examination 85 days after planting showed that cloves from diseased bulbs produced 51 percent mosaic plants, while cloves from healthy plants showed only about 5 percent infection Altstatt and Smith, (H. P.).

Further experiments on the harvesting and drying of garlic and the effects of these treatments on disease control are described under the Division of Agricultural Engineering.

Prevention of onion neck rot in cold storage. Experiments designed to prevent excessive loss from neck rot in Bermuda white wax onions under cold storage conditions have been carried on in cooperation with the United States Cold Storage Company, Dallas. During the first year's work, considerable reduction in the amount of neck rot was obtained through the use of wooden crates instead of sacks as storage containers. Onions harvested during dry weather developed only 5 to 10 percent neck rot in storage, as compared with 20 to 50 percent decay among onions taken from the field on a rainy day. Certain chemical treatments, especially boric acid and sodium borate applied in the form of a dust to the onions at time of placement in cold storage seemed to prevent neck rot and maintain a bright appearance of the onions under cold storage conditions. Dunlap and Lyle.

Further work on the control of vegetable diseases is reported under Substation Nos. 15, Weslaco and 19, Winter Haven.

Rose diseases

Nematode root-knot resistance in roses. Examination, both macroscopically and microscopically, of roots of Multiflora X Blanda plants (grown at the Tyler substation) showed them to be entirely free of natural nematode infestation, while Multiflora (Welch) plants grown adjacent to the Multiflora X Blanda were found to be badly infested. A technique to show readily the presence of nematode eggs or larvae in small roots has been developed. Altstatt.

A report of the rose disease work at Tyler is given under Substation No. 2.

Peach diseases

Spraying of peaches for scab and brown rot. Work has been continued at the Nacogdoches substation with sulphur sprays on peaches to control scab and brown rot. Additional spraying work has also been conducted on a cooperative basis in commercial orchards at Stephenville and De Leon. At Nacogdoches, the trees sprayed on May 5, June 3, and June 21 with the following formula: monohydrated zinc sulphate 2 lb., hydrated lime 4 lb., wettable sulphur 3 lb., lead arsenate 1 lb., and water 50 gal., produced 75 percent clean fruit as compared with 11 percent clean fruit on the unsprayed trees. During the past season, the above formula containing only 3 lbs. of wettable sulphur gave as good results as the previously-used formula containing 5 lbs. of wettable sulphur. The possibility of using less spray material should encourage the grower to spray more often and to spray more thoroughly than he would when using a more expensive spray mixture. Dusting experiments were also conducted at Nacogdoches, comparing the effectiveness of 6 applications of sulphur-lead arsenate-lime dust with sulphur-cryolite dust and comparing both of these treatments with the regular spray program. The results of the dusting, which was done by hand with a crank duster, were much inferior to those obtained from spraying with a power sprayer and in some cases only little increase in percentage of clean fruit was obtained. Additional data on the effectiveness of the sulphur sprays applied in an orchard at De Leon for brown-rot control were obtained by placing samples of the sprayed and unsprayed fruit in cold storage. After the peaches had been stored at 38° F. for 5½ months, 68 percent of the sprayed fruits were sound whereas among the unsprayed peaches only 33 percent were sound.

From the results of the Station's work for the past two years, it has become evident that the standard method for control of peach scab and brown rot, using sulphur sprays, gives adequate protection against these diseases in the field under Texas conditions. Possbily further work along this line will not be necessary. It is felt, however, that the control of the oriental fruit moth is most important in the control of peach brown rot, since brown-rot decay follows injury by this insect.

Watkins, Morris, and Langley.

Work on citrus diseases and chlorosis of various plants is described in the reports of Substations Nos. 15, Weslaco and 19, Winter Haven. Experiments dealing with diseases and physiological disorders of rice are included in the report of Substation No. 4, Beaumont.

POULTRY HUSBANDRY

Protein Requirements of Chicks

Two experiments with 14 to 22½ percent of protein on growing White Leghorn chicks for a period of 10 weeks indicate that the gains were sufficiently high to warrant the use of 20 and 22½ percent protein.

Equal amounts of dried fish meal, cottonseed meal and soybean meal made up the protein concentrate portion of the ration. New Hampshire chicks fed 17 to 21 percent protein for 10 weeks with decreasing amounts of protein as the chickens become older gave satisfactory results with 17 to 19 percent protein for the entire period indicated that the pullets make good gains on slightly smaller amounts of protein than do cockerels. The project is conducted in cooperation with the Feed Control Service.

Sherwood, Couch, and Fuller.

Varying Amounts of Vitamin D Fed With a High Level of Manganese

Groups of hens that had finished their first or second laying year were fed on a basal ration containing 204 parts of manganese per million parts of feed and 22 A. O. A. C. chick units of vitamin D per 100 grams supplemented with 20, 40, and 80 A. O. A. C. chick units of vitamin D per 100 grams of feed without access to direct sunlight. The hens in this test receiving 102 A. O. A. C. chick units of vatimn D per 100 grams of feed laid more eggs, and their eggs hatched better than did those receiving 62 or 42 A. O. A. C. chick units of vitamin D per 100 groms of feed.

Couch, Fraps, and Sherwood.

Carotene Destroying Power of Animal Protein Feeds

The carotene destroying power of fish meal, meat and bone scrap, and tankage in rations combining nine percent of animal protein with 175 micrograms of carotene in oil per 100 grams of feed. Two samples of animal protein feed containing approximately 60 to 80 percent carotene destroying power as determined by the Division of Chemistry gave poorer gains than protein feeds containing 10 to 20 percent carotene destroying power. It required more feed to produce a unit of gain with the birds receiving rations containing protein feed of high carotene destroying power than with those containing protein feeds of low carotene destroying power. Further work is being done on this project.

Sherwood, Couch, Fraps, and Fuller.

Maximum Crude Fiber Content of Chick Rations

An experiment was conducted in cooperation with the Division of Feed Control to determine the amount of crude fiber that can be tolerated by chicks in order to know whether the chemical standards (particularly the maximum amount of crude fiber that may be allowed) adopted by the Feed Control Service for chick starters are correct. The data indicate, as did the data in last year's work, that 7 percent fiber was as high as could be tolerated when this fiber came from oat hulls. Pulverized cellulose was used in another experiment to bring up the fiber to 7, 9, and 11 percent. The results seemed different than where the oat hulls were used, because the gains were satisfactory with larger amounts of fiber, and the feed required to produce a unit of gain was not high with amounts of fiber as high as 11 percent.

Sherwood, James, Carter, and Fuller.

Turkey Marketing

The turkey marketing projects, is a combination of research and extension, began July 1, 1941. A study of production practices, and marketing is being made. No data are yet available. Weekly radio talks are used as the outlet for most of extension type material. This as a cooperative project among the Feed Control Service, the Poultry Division, and the Farm and Ranch Economics Division of the Experiment Station and the Extension Service.

Baker, Paulson, McCarthy, and Fuller.

Requirements of Finishing Rations for Poults

Preliminary experiments were begun to find the type of ration needed to finish the undernourished, range fed turkey. Two groups of poults were used; each having received a ration containing 14 percent protein until 20 weeks of age. From 20 to 28 weeks of age, group one was fed a finishing ration containing 17.5 percent protein, 1.4 percent calcium, .85 percent phosphorus, and 4 percent fat. Group two was fed a ration containing 13 percent protein, .8 percent calcium, .5 percent phosphorus, and 6.5 percent fat.

Ration two was low in protein, calcium, phosphorus, and vitamins and was high in fat which is typical of fattening rations. The average gain of male and female birds from 20 to 28 weeks was 7.3 pounds for ration one and 3.1 pounds for ration two. Mortality was very low in each group.

This project was conducted in cooperation with the Feed Control Service. Thompson, Sherwood, and Fuller.

Calcium and Phosphorus Requirements of Poults

Three all-mash rations were used. Ration one contained 2.8 percent calcium and 1.5 percent phosphorus; ration two 1.4 percent calcium and .85 percent phosphorus; ration three .9 percent calcium and .55 percent phosphorus. The protein level was 17.5 percent. Bronze poults were fed these rations from 8 to 20 weeks of age.

At the end of this period, the average weight of male and female poults on ration one was 10.1 pounds, on ration two 11.2 pounds, and on ration three 10.8 pounds. This was a gain of 7.7 pounds, 8.2 pounds, and 8.2 pounds respectively. Dented breasts and perosis occurred only in group two. There was no mortality in any of the groups. Studies will be continued on the calcium and phosphorus requirements.

This project was conducted in cooperation with the Feed Control Service. Thompson, Sherwood, and Fuller.

Protein Requirements of Poults

Three groups of Bronze turkeys from a common source were fed all-mash rations containing three different levels of protein, 22.5 percent,

17.5 percent, and 14 percent protein. The calcium level was 1.4 percent and the phosphorus was .85 percent. The poults were fed these growing rations from 8 to 20 weeks of age. The average weight of males and females on 22.57 percent protein was 11.5 pounds, on 17.5 percent protein was 11.2 pounds, and on 14 percent protein was 6.8 pounds. This was an average gain of 8.6 pounds, 8.2 pounds, and 3.9 pounds, respectively. There were some cases of perosis, very low in all groups.

This project was conducted in cooperation with the Feed Control Service.

Thompson, Sherwood, and Fuller.

Strain Differences in Turkeys

The study was begun in the spring of 1941. Eggs from four strains of standard Bronze and one of a Broad Breast-Standard Bronze cross were secured. The feeding and management practices of the polts were kept as near alike as possible with the only variably being the strain. Growth, feed consumption, and deformities were recorded. Average weight for the male and female turkeys at 24 weeks was as follows: strain one, 11.3 pounds; strain two, 13 pounds; strain three, 10.5 pounds; strain four 14.2 pounds; and strain five, Broad Breast, 12.4 pounds. Strain four with the heaviest weight was the Broad Breast-Standard Bronze cross.

This project was conducted in cooperation with the Feed Control Service and will be continued.

Thompson, Sherwood, and Fuller.

PUBLICATIONS

Station publications printed and distributed during the fiscal year ending August 31, 1941 include ten bulletins and three circulars. Both the Fifty-second and the Fifty-third annual reports were released during the year. Staff members reported publication of 29 papers in scientific journals. Fifty-five mimeographed progress reports were distributed to the press, to county and home demonstration agents, vocational teachers, and to other agricultural workers. Circular No. 93 abstracted all publications issued in 1940 and carried a complete subject list of publications for distribution. This circular also carried abstracts of fifty-five articles in scientific journals. Soil survey reports of Cameron and Hidalgo counties were reprinted, the regular issues of 1928-1929 having become exhausted.

All of the publications including the progress reports and a number of press releases were supplied promptly, as issued, to the local broadcasting station where most of them were digested and announced to the public over the WFAA, WBAP, KPRC, and WOAI hookup with WTAW, and several members of the staff cooperated in digesting and presenting this information on the regular hookup programs.

A list of station publications by title, number, and authors follows.

Technical Papers

610. Effect of Metal Skewers on Cooking Time and Tenderness of Beef; Sylvia Cover. Food Research, Vol. 6, pp. 233-238, 1941.

616. The Effect of Diet on the Pantothenic Acid Content of Eggs; E. E. Snell, Esther Aline, R. J. Couch, and P. B. Pearson. Journal of Nutrition, Vol. 21, pp. 201-205, 1941.

617. New Genetic Characters of the Tomato; P. A. Young. The American Naturalist, Vol. 75, pp. 280-282, May-June, 1941.

641. Abstract Pollen Studies with Plums Representing Certain Species and Interspecific Hybrids. I. Apparent Viability. II. Size.; W. S. Flory, Jr. Abstract in 42nd. Annual Proc. South. Agri. Workers Association, Atlanta, pp. 171-172, 1941.

643. Some Factors Causing Fading in Color of Rose Blooms; J. C. Ratsek. From Proceedings of the American Society for Horticultural Science, Vol. 39, pp. 419-422, 1941.

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668. Margarine Legislation; W. T. Mickle. Journal of Farm Economics, Vol 23, No. 3, pp. 567-583, August 1941.

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694. Report on Riboflavin; A. R. Kemmerer. Journal of the Association of Official Agricultural Chemists, Vol. 24, No. 2, pp. 413-423, May 1941.

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STATION PUBLICATIONS

Bulletin	Title	Author	Number Pages	Number Copies
593	Commercial Fertilizers in 1939–40	G. S. Fraps, T. L. Ogier, and S. E. Asbury	47	9,000
594	Commercial Feeding Stuffs, September 1, 1939 to August 31, 1940	F. D. Fuller and James Sullivan	221	9,000
595	Iodine in Drinking Waters, Vegetables, Cottonseed Meal, and Roughages	G. S. Fraps and J. F. Fudge	25	7,000
596	Onion Fertilizer Experiments at Laredo, Big Wells, and Eagle Pass, Texas	Leslie R. Hawthorn	20	7,000
597	Land Use in Relation to Sedimentation in Reservoirs, Trinity River Basin, Texas	L. P. Gabbard and Alexis N. Garin	65	7,000
598	Infectious Entero Toxemia (Milk Colic) of Lambs and Kids	I. B. Boughton and W. T. Hardy	20	7,000
599	The Use of Sudan Grass Pastures and Other Feeds for Beef Production	J. H. Jones, J. M. Jones, R. A. Hall and E. M. Neal	29	7,000
600	Productive Energy of Corn Meal, Alfalfa Leaf Meal, Dried Buttermilk, Casein, Cottonseed Meal, and Tankage as Measured by Production of Fat and Flesh by Growing Chickens	G. S. Fraps and E. C. Carlyle	41	7,000
601	Citrus Varieties for the Lower Rio Grande Valley	W. H. Friend and J. F. Wood	36	9,000
602	Fertilizer for Rice in Texas	R. H. Wyche	18	7,000
Circulars				
91	Plant Diseases in Texas and Their Control	A. A. Dunlap	71	15,000
92	Simplified Instructions for Control of Cotton Insects	F. L. Thomas	4	150,000
93	Abstracts of Bulletins Nos. 581–595, Circulars Nos. 86–90 and Other Publications During 1940	A. D. Jackson	51	65,000
	Fifty-second Annual Report, 1939	A. B. Conner	304	6,000
	Fifty-third Annual Report, 1940	A. B. Conner	294	5,000

RANGE ANIMAL HUSBANDRY

Disease Resistance in Animals

(In cooperation with Division of Veterinary Science)

Five of the sheep originally selected for resistance to stomach worm, *Haemonchus contortus*, have now been maintained for over three years under conditions of extremely intense natural exposure. Of sheep which had survived exposure prior to 1941, the mortality was 6.3 percent during 1941. Among the 35 survivors there are 8 which have never shown symptoms of parasitism. Among 4 ewes and 15 rams purchased in June and subjected to extreme exposure to the parasite, the mortality was 57.9 by the end of the year.

Of lambs from apparently resistant parents, the mortality was 85.7 percent. That of the untreated control group and of the group with only one resistant parent was 100 percent. The natural infection was the most intense yet observed.

Thirteen ½ and ¾ Angora buck kids were exposed to the same intense infection. The mortality was 92.3 percent, almost entirely due to *H. contortus*. The lone survivor showed symptoms, but recovered and made good growth.

Work with the toxin of Loin Disease, using mice, has been continued. In an attempt to further intensify the resistance of the selected line, the surviving males are mated to stock females for more complete progeny testing. These tests are not complete.

Mice selected for resistance to *Nippostrongylus muris* have been continued, but the line selected for greater susceptibility has been lost. The resistant line still shows a considerable amount of variability in resistance.

Warwick, Turk, Berry, and Schmidt.

Cytological Studies in Sheep and Goats

Preliminary cytological study was made of testicular material from the Barbary sheep, also known as the Aoudad *(Ammotragus lervia)*. This species differs in its chromosome complex from domestic sheep in that it has only two large V-shaped chromosomes as compared to six in the Rambouillet. The presence of the two V's also differentiates this species from the goats, as they do not possess any large V-shaped choromosomes. There is one choromosome in the complex smaller than any of the others. This is probably the sex chromosome. Favorable testicular material for the complex analysis of the chromosomes has not been obtained but the number found in most of the cells is 58.

Additional observations by the use of the aceto-carmine smear method on testicular material from the goat confirm previous studies in which the diploid choromosome number was found to be 60 and all the largest chromosomes are long rods.

Berry and Warwick.

The Inheritance of Fiber Characteristics in Rambouillet and Romney Sheep and Their Crosses

A ram of the first back-cross generation (¾ Rambouillet + ¼ Romney), selected for approximately the same staple length as the F_1, has been

back-crossed to Rambouillet ewes and a few of the lambs have been born. Also, some additional animals of the same breeding as the back-cross ram have been raised. Segregation of staple length (rapidity of fiber growth) in the back-cross is from that of the short staple (5-6 cm.) of the Rambouillet mothers to approximately the 10 cm. of the F_1 sires.

Warwick and Davis.

Transference of the Genes for Fineness of Fiber from Non-Angora to Angora Goats

(In cooperation with Animal Husbandry Dept., A. & M. College)

Two of the eight 7/8 Angora bucks are being retained for further study, but it is doubtful if they are retaining enough of the desired fineness of fiber. Fifteen buck kids sired by the finest fleeced F_1 buck (Angora sire x non-Angora dam) and out of purebred Angora females are also being retained for study of their mohair as they become adult. All are very vigorous and have desirable fineness at this age.

Warwick, Davis, and Miller.

Interspecific and Intergeneric Hybridization with Sheep and Goats

Previous results have shown that when female goats are bred to male sheep in about 50 percent of the matings fertilization occurs and the hybrid embryos develop up to 50-60 days before they are aborted. However, when the reciprocal cross is made the ewes come in heat at the next estrus period following each breeding. In order to ascertain if fertilization occurs when female sheep are mated to male goats, three ewes were artificially inseminated with sperm from goats and then killed on the second or third day after breeding and the reproductive tracts were examined. Five eggs were recovered, two of which showed abnormal segmentation, indicating that they had been stimulated by the goat sperm even though further development is arrested.

Among the 20 offsprings from breeding F_1 Rambouillet x Mouflon *(Ovis musimon)* rams to Rambouillet ewes, one ram with intermediate tail-length, like F_1 and that is non-hairy, is now of breeding age. This ram has been mated with 23 Rambouillet ewes for 1942 lambs. These matings have been made for additional testing of the mode of inheritance of the non-hairy character and to transfer genes for short tail from the Mouflon species to Rambouillets. Warwick, Berry, and Davis.

Inheritance of the Ridgling Characteristic in Goats

Progress made in this study during the past year is reported under Substation No. 14, located near Sonora. Warwick and Dameron.

Inheritance of Polled Character in Fine-Wool Sheep

Four more Rambouillet rams of polled breeding raised in this experiment have been tested for homozygosity. Two of these were found to be homozygous for the polled or hornless pair of genes, but both are car-

riers of the gene for cryptorchidism, which we had previously found to be segregating as a recessive. One lamb with a testicle retained was found for the first time in the registered Rambouillets of strictly horned breeding. This lamb was typically horned.

The study of polled and horned inheritance in Merinos, which is in cooperation with the Animal Husbandry Department, School of Agriculture, is being continued. The third polled ram tested has been found to be homozygous for the polled-horned pair of genes, but he has not yet been tested for cryptorchidism. One other polled Merino ram, raised in the experiment, is in process of being tested.

Warwick, Dameron, Dunkle, and Milled.

A Study of the Inheritance of Skinfolds on Rambouillet Sheep

(In cooperation with U. S. Dept. of Agriculture.)—Inheritance studies within the breed have been continued at the Ranch Experiment Station. In addition, Corriedale and F_1 ewes were bred to heavy C and B type Rambouillet rams in order to more effectively study the genes responsible for skinfolds. Progeny resulting from these matings point to the high degree of apparent dominance of the smooth over the wrinkly type.

Jones, (J. M.), Warwick, Dameron, and Davis.

Inheritance of Type in Angora Goats

This study, which is under way at the Ranch Experiment Station, Sonora, has quite definitely indicated that acceptable fineness of mohair fiber may be produced by either the ringlet or flat lock types of Angora goats. Jones, Warwick, Dameron, and Davis.

Relation of Age of Animal to Fineness of Wool and Mohair

Subsequent studies with wool have substantiated earlier findings that the differences are significant. These differences, however, are not sufficiently great to influence the commercial value of the fleeces produced by the older sheep, as was found with mohair. The maximum diameter of fiber is reached at an earlier age with wool than with mohair. These results should place the selection of stud animals on a sound basis, making it possible to obtain fleeces more uniform in fineness. However, even the most uniformly fine wool fleeces need more staple length than the average, in order to be the most valuable.

Jones, (J. M.), Dameron, and Warwick.

Vitamin A Requirements for Beef Cattle and Sheep

(In Coop. with Divs. of Chemistry & Vet. Science, TAES, & Bureau An. Industry, USDA.)—In a study of vitamin A requirements for fattening beef cattle, conducted in cooperation with the Bureau of Animal Industry at Substation No. 7, Spur, during the current year, fifty steer calves were depleted of vitamin A reserves, afterwards being placed on 1250, 1500, 2500, 3000, and 5000 micrograms of carotene in the form of al-

falfa leaf meal per 100 pounds live weight daily during a 140-day fattening period. There were no significant differences in gain, carcass weight, or carcass grade between groups. Calves fed 1250 and 1500 micrograms developed complete night blindness; those fed 2500 and 3000 micrograms showed considerable impairment of night vision, although less than calves on the two lower levels. The calves fed 5000 micrograms, although night blind when placed on that level, were essentially normal in night vision at the end of the 140-day test.

Jones, (J. H.), Dickson, Jones, (J. M.), Marion.

Feeding Problems Affecting Beef Production

(In cooperation with U. S. Experiment Station, Big Spring, Texas and Bureau of Animal Industry, USDA.)—The study of the influence of calcium, magnesium, phosphorus, and carotene intake on the occurrence of urinary calculi in fattening beef calves was continued. The same basal ration was fed to all calves; however, the groups received different mineral supplements in varying ratios and quantities. Significantly more calculi, average 10.3 grams per steer, were present in the bladders of the steers fed a ration high in magnesium than in any other group. Two of eight steers in the high magnesium ration group were slaughtered during the course of the experiment because of stoppage of urethral tract. Steer fed a high level of calcium and phosphorus in the form of bone meal revealed a relatively small amount of urinary calculi. High levels of calcium in the form of pulverized oyster shell appeared in this test to exert a favorable influence in lowering the incidence of urinary calculi. A carotene supplement in the form of alfalfa leaf meal failed to increase gain or finish; however, in this group a smaller amount of calculi were found than in a similar group which did not receive the carotene supplement. Jones, (J. M.), Keating, and Jones, (J. H.).

Ground Hegari Fodder vs. Ground Red Top Fodder in Rations for Fattening Steers

Ground hegari fodder was superior to ground red top fodder in rations of fattening two-year-old steers during a 156-day test at Substation No. 9, Balmorhea. The cattle fed hegari fodder made greater gain that yielded heavier and higher grading carcasses.

Jones, (J. H.), and Bayles.

Alfalfa vs. Ground Quadroon Stover and Ground vs. Unground Quadroon Heads for Fattening lambs

In a test conducted at Substation No. 16, Iowa Park, no advantage resulted from grinding of quadroon heads when fed either with alfalfa hay or ground quadroon stover as roughages. Lambs fed alfalfa hay as roughage made an average gain of 30 pounds per head during a 112-day period as compared with 22.3 pounds for those receiving the ground quadroon stover as roughage.

Jones, (J. M.), Brooks, and Jones, (J. H.).

Linseed meal vs. Cottonseed meal in Rations of Fattening Beef Calves and Lambs

In a comparison of Texas manufactured 37% protein linseed meal and 43% protein cottonseed meal fed in equal amounts to fattening beef calves at Substation No. 1, Beeville, there were no significant differences in gain and finish. Likewise, these protein supplements, when fed to fattening lambs, produced practically equivalent results.

Jones, (J. M.), Hall, Jones, (J. H.), and Neal.

Blackstrap Molasses in the Beef Cattle Fattening Ration

The use of blackstrap molasses as a replacement for one-fourth of the daily allowance of ground threshed hegari during a 153-day feeding trial at Substation No. 1, Beeville, resulted in smaller gain and lower carcass grade. Jones, (J. M.), Hall, Jones, (J. H.), and Neal.

Beef Cattle Investigations Relating to Mineral Deficiency Studies in Range Production

(In coop. with Divisions of Chemistry and Vet. Science, and Bureau of Animal Industry, USDA)

Mineral deficiency studies in cooperation with the Bureau of Animal Industry and the King Ranch located near Falfurrias reached their fourth year. Three groups of cows on a phosphorus deficient range were individually fed definite quantities of phosphorus. One group received it in the form of bone meal, another as di-sodium phosphate, while a third group received bone meal with small amounts of iron, manganese, copper, cobalt, zinc, and boron. The fourth, a check group, received no phosphorus supplement. The percentage calf crop from the cows fed the phosphorus supplement averaged considerably above that of the check group. The calves from the cows receiving the phosphorus supplement had an advantage of approximately 65 pounds more per head at weaning time than did those from the check group cows. All of the heifers retained from the mineral groups were individually fed di-sodium phosphate. Sixty-three percent of these heifers calved during the year as compared to 23 percent of those heifers retained from the control group. The inorganic phosphorus content of blood samples collected periodically continued to be an accurate index of phosphorus sufficiency or deficiency.

Tash, Jones, (J. M.), and Black.

Fattening Angora Wethers in Dry Lot

(In coop. with School of Agriculture, A. & M. College of Texas)

Angora goat wethers one, two and three year old, were compared with good quality Rambouillet lambs during a 100-day fattening period at College Station. The average daily gain per head for all goats was 0.16 pound as compared with 0.31 pound for the lambs.

In a study of the carcasses, it was found that the percentage of edible

portion was equally as high in the goat carcasses as in the lamb carcasses. The ratio of fat to lean was almost identical both for fat goats and fat lambs. A committee of judges pronounced the goat meat (chevon), which was served as chops, barbecue and chili, as being very desirable in flavor. Miller and Jones, (J. M.).

Accuracy of Small Wool Samples for Shrinkage Determination

This year's data are based on small samples of spring eight months wool from twenty flocks in Bandera County. The method of selection of these samples and treatment in scouring remained the same as previously reported in the Fiftieth Annual Report (page 55).

These results indicate that this method has value for sampling the many small clips in this particular section of the State. By use of a correction factor, to compensate for the difference in shrinkage between small hand samples and entire fleeces, shrinkage figures obtained may be expected to be within $\pm$ 1.13 percent of the true shrinkage of the wool from the entire flock. Davis and Jones, (J. M.).

Determining Grades and Shrinkages of Texas Wools

During the current year approximately 27,000 pounds of Texas grease wool samples, 85 percent of which graded as fine, were scoured at the Research Wool Scouring Plant for shrinkage determinations. These samples represented a larger area than those scoured during the previous year. In the main, these respective samples constituted not less than 25 fleeces. The average shrinkage of all sample wool scoured during the year was 60 percent although the shrinkages ranged from 52 percent to 72 percent. This study has definitely indicated the importance of a fairly accurate knowledge of wool shrinkages and has been of inestimable value to wool producers in the improvement of their flocks.

Individual fleeces were scoured from 191 registered ewes and 32 Rambouillet rams from the Ranch Experiment Station flock at Sonora. The shrinkage of the fleeces from the ewes averaged 56 percent while the ram fleeces showed an average shrinkage of 58.5 percent. These shrinkages averaged considerably below the results generally obtained and it is believed may be attributed to the high rainfall preceding shearing.

Davis, Jones, (J. M.), and Dameron.

RURAL HOME RESEARCH

The Chemical and Physical Factors Responsible for Tendering Meat During Cooking

Top-round and bottom-round roasts were cooked in an electric oven and in a large water bath. The cooking temperature was held constant at 90°C and the roasts were removed at an internal temperature of 80°C. Cooking time for the 2 cuts respectively were 2.4, 1.9 hours in

the water and 31.8, 26.4 hours in the oven. Results showed that the oven-cooked roasts were tender and the water-cooked meat frequently tough. The presence of moisture around the water-cooked meat appeared to be unsuccessful in making the meat tender. It seems that "moist heat" in the sense of added moisture is not necessary for making tough meat tender.

In order to determine whether tendering of meat during cooking may be influenced by the change from collagen into gelatin, test tubes containing tendonpowder suspended in water were subjected to heat treatment at temperatures which seemed to be important in tendering meat during cooking. In both series of tests the collagen breakdown was determined at regular intervals by removing individual tubes for analysis. Results are not yet available.

A manuscript entitled "The Effect of Metal Skewers on Cooking Time and Tenderness of Beef" was published in *Food Research* 6:233-238, 1941.

Cover.

Processing of Canned Meat

(In cooperation with the Division of Veterinary Science)

Results have shown that 50 minutes processing at 15 pounds pressure is sufficient to destroy the botulinus organism in No. 2 cans of ground meat. Inoculation tests with No. 3 cans at 15 pounds pressure are now in progress. Tests using 10 pounds pressure have not been completed. Preliminary work with a canned luncheon meat has been started.

Cover, Schmidt, and Turk.

Effect of Degree of Fatness on Tenderness of Lamb

(In cooperation with the School of Agriculture, A. & M. College of Texas)

Paired lambs are fed individually, one full-fed and the other limited fed. The left legs are cooked and tested for tenderness by the paired-eating method. Separable fat is obtained for each wholesale cut in the right side of the carcass. Tests will be continued until the data collected are sufficient to warrant conclusion. Cover, Miller, and Murphy.

The Effect of Cooking on the Thiamin Content of Meat (Beef)

(In cooperation with the School of Agriculture, A. & M. College of Texas)

This project is supported by a grant from the National Live Stock and Meat Board through the National Research Council. The funds were not available until December and no progress can be reported at this time.

Cover and Pearson.

The Mineral Composition of Vegetables Grown in Representative Region of Texas and the Relation of Variation in Mineral Content to the Probable Nutritive Value

(In cooperation with the Divisions of Horticulture and Chemistry and with 5 other southern states, the U. S. Plant Breeding Laboratory in Charleston, S. C., and Texas Technological College)

Variance analysis has shown that there are no statistically significant differences in the iron content of the greens grown in 1940 under the factorial design for 16 fertilizer treatments. Greens from College Station averaged 195 ppm; those from Winter Haven 137 ppm. The only statistically significant effects upon the phosphorus in the greens was due to the nitrogen treatment (positive effect) and nitrogen + potassium treatment (negative effect) in the greens grown at College Station. Statistically significant negative effect on the calcium in the greens was produced by the nitrogen treatment both at Winter Haven and College Station.

Statistical analysis for the four varieties of greens grown at College Station in 1941 showed all the fertilized to be highly significantly richer in phosphorus than the corresponding variety of unfertilized (Seven Tops 0.90% vs. 0.41%, Purple Top 0.87% vs. 0.36%, Golden Ball 0.85% vs. 0.42%, Shogoin 0.73% vs. 0.37%). The unfertilized greens were significantly higher in calcium than the fertilized in three varieties—Seven Tops (2.97% vs. 2.17%), Purple Top (3.05% vs. 2.31%) and Golden Ball (3.07% vs. 2.28%), while Shogoin unfertilized (3.00%) and fertilized (2.27%) did not differ significantly. Varietal differences in iron content were not significant, average content ranged from 79 to 191 ppm in the fertilized and from 172 to 213 ppm in the unfertilized greens. The fertilized fresh greens averaged 92.7% water, unfertilized, 90.4%; differences were statistically significant in all varieties except Golden Ball. Yields of fertilized greens (ranging from 71 to 129 grams per foot in the four varieties) were not significantly different in any variety from those of the unfertilized (112 to 205 grams per foot).

Varietal differences in the fertilized planting were significant only with respect to phosphorus content, (three varieties exceeded Shogoin) and yield, (Purple Top and Shogoin exceeded Golden Ball and Seven Tops). In the unfertilized planting only iron showed significant differences, (Seven Tops and Golden Ball exceeded Purple Top).

Stage-of-growth samples of greens showed no marked and consistent differences in any respect, though protein tended slightly to decrease and fiber to increase with age.

Cowpeas fertilized and unfertilized, averaged respectively 0.05% and .055% calcium, 0.465% and 0.435% phosphorus, and 78.5 ppm and 92.5 ppm, iron on the moisture-free basis. Whitacre.

Effect of Tea upon the Energy Metabolism of Children

The final report of this study is to be published in the Journal of Home Economics, March 1942. Caffein (.03 gram) in 300 cc of iced tea and 300 cc of lemonade carrying the same amount of lemon juice and sugar as the tea produced strikingly similar effects upon 15 children of 10 to 13 years with respect to duration of stimulation, maximum observed rise, and rate of rise and fall in oxygen consumption. Whitacre.

Study of Body Measurements for Sizing Children's Garments and Patterns

U. S. D. A. Miscellaneous Publication No. 366 July, 1941, the second report on this project by the Bureau of Home Economics presents a technical account of all procedures and compares data from the 14 participating states.

The analysis of the Texas data classified on a basis of parent's occupation into 6 groups, professional, semi-professional, business, farmer, skilled labor, and common labor, is nearing completion. A final report is in preparation. Whitacre.

The Serviceability of Garments as Affected by Varietal and Regional Differences in Cotton Fibers and Methods of Harvesting

Acala and Rowden, varieties of cotton which show regional differences and which differ widely in fiber properties have been grown for two seasons in two regions, the Blacklands at Temple and the High Plains at Lubbock. Two methods of harvesting, snapping and picking, have been used at Lubbock.

Analysis of the fiber properties and spinning tests of the cottons grown in 1940 has shown that cotton grown at Temple to be stronger and one grade higher than that grown at Lubbock, but the Lubbock cotton was the longer. The picked cotton was of higher grade, longer, and stronger and the yarns of better appearance than the same varieties snapped.

The analysis of the fiber properties and the spinning tests of the 1941 crop are underway. It is highly probable that the manufacturing of the yarns, fabrics and garments, and all tests on fabrics and garments will have to be postponed until the present rush in the mills is over.

Grimes.

SOIL SURVEY

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

During 1941 soil surveys were carried on continuously in McLennan and Cherokee counties by soil surveyors of the Experiment Station and Bureau of Plant Industry and for about 4½ months in Uvalde County by soil surveyors of the Bureau of Plant Industry. The base map used in

McLennan and Cherokee counties were aerial photographs of a scale of approximately 4 inches to the mile, but in Uvalde County plane tables were used to construct the base map of 2 inches equals one mile. A total of about 360,000 acres were surveyed in these three counties during the year.

In addition to the soil types and phases indicated on the soil maps, symbols are placed on each area delineated to indicate slope, erosion, and land use features thus providing a map for use of planning agencies of the Soil Conservation Service and others. The system of soil classification and mapping continues to be correlated according to the national standard used in making progressively the detailed soil map of the United States which has been in process of survey by the U. S. Department of Agriculture for many years.

The aerial photographs used in the serveys were furnished by the Soil Conservation Service.

Inspections of Soil and Conservation surveys were made of a number of soil survey areas and of Soil Conservation districts by the inspection staff of this division consisting of the chief of the division, assisted by E. G. Fitzpartick of the Bureau of Plant Industry and by Harvey Oakes of the Soil Conservation Service, both of the above mentioned men having been detailed to this office to assist in inspection duties which have become increasingly heavy because of the large number of Soil Conservation districts that have been established during the last year.

Cherokee County

The survey of Cherokee County has continued throughout the year with one Bureau of Plant Industry man and one Experiment Station man working together. About 62,000 acres were surveyed during the year. Due to the many soils encountered here and their occurrence in small intermingled areas, the progress has been slow. Only one or two new soils were encountered during the year. Nearly 40 percent of the county has been completed. Smith, Mowery, Butler, and Carter.

McLennan County

About 63 percent of this county has been completed. Nearly 190,000 acres were surveyed during the year. Several men worked only brief periods on this survey due to one man having been drafted for army service and two others resigning to take up other work. During the year the leader, Mr. Templin, was called away for several short periods of special survey duties in other parts of the State. No new soils have been encountered during the year.

One man of the Soil Conservation Service worked for several weeks in this county.

Templin, Nabors, Horton, Williams, Atkins, Voigtel, and Carter.

Uvalde County

Field work contined during the winter and early spring in Uvalde County with two surveyors of the Bureau of Plant Industry covering about 110,000 acres. The work was confined to the lower smooth plain of the county and about one fourth of the county has been surveyed up to this time. In May the surveyors were withdrawn to work in northern states for the summer and fall seasons. Mogen, Knobel, and Carter.

Special Surveys

During the year detailed soil surveys were made of the soils of Substation No. 7 at Spur, No. 20 at Stephenville, Brazos Valley Experimental Farm near College Station, and of the soils of the Substation No. 3 at Angleton. These surveys were made at the requests of the Superintendents to provide a basis for planning research work of various kinds.

Templin.

SWINE HUSBANDRY

Cottonseed Meal as a Feed in Swine Nutrition

Cottonseed meal as a feed for swine is being further investigated by the use of both chemical and biological methods.

Cottonseed meal free from any toxic qualities (as indicated by feeding tests with guinea pigs) has been repeatedly produced in the laboratory with experimental equipment. Processing factors include time, temperature, and moisture content of the seed during the "cooking," and the manner of introducing added moisture. Chemical changes which must take place during the processing are being investigated.

Lyman and Hale.

A Study of the Relationship of Genetic Factors to Vitamin A Requirements in Mammals

Additional tests of two inbred lines of albino rats have confirmed earlier differences found in vitamin A index. Attempts to determine if the differences noted were due to differences in ability to store the vitamin or differences in efficiency of utilization were made. Conclusive evidence has not been obtained due to differences in body weight reached by the two groups before the tests began and to the large variability in response within groups to the small quantities of pro-vitamin A fed to depleted rats. Quisenberry and Hale.

Quantitative Requirements of Vitamin A for Pigs

This year when the ration of the sows contained 200 micrograms of carotene per 100 grams of feed, the pigs in both the first and second litters were apparently normal.

Three groups of five pigs each from sows receiving 200 micrograms of carotene per 100 grams feed were individually fed rations containing 100, 200, and 300 micrograms of carotene per 100 grams of feed furnished by alfalfa leaf meal.

One hundred micgrograms of carotene per 100 grams of feed produced less economical gains than did 200 micrograms. The pigs receiving 300 micrograms showed no advantage over the pigs getting only 200 micrograms.

Livers from the two pigs that were killed at the beginning of the test contained only 2 to 3 parts per million of spectro vitamin A.

Hale and Fraps.

Concrete Hog Wallows for Fattening Hogs

Ten pigs (48.7 pounds initial weight) were fed in individual pens containing a concrete hog wallow, while ten pigs, averaging 48.6 pounds, were without access to a hog wallow. The difference in gain was ten pounds per pig in favor of the hog wallow lots during the 90-day test. Last year, starting the test with 65-pound pigs, the difference was 25 pounds in favor of the hog wallow lots. These tests were conducted during the months of June, July, and August, with an average temperature of 82 degrees F.

The hog wallow gave greater returns with the heavier pigs. Hale.

Sudan Grass and Oats Pasture for Fattening Pigs

The value of Sudan grass and oats pasture for fattening pigs is being continued. Previous results vary with respect to feed saved and returns from the pasture due to climatic conditions, but on the average, the results show from thirty to fifty percent saving in the protein supplement required when Sudan or oats pasture furnishes grazing for fattening pigs. The gains, however, have been just as great with the dry-lot-fed pigs as they have with the pasture-fed pigs. Hale.

VETERINARY SCIENCE

Loin Disease in Cattle

The studies on our loin disease cultures are being continued with special reference to the possibility of developing some kind of immunization against the disease. Schmidt.

Infectious Bovine Abortion

(In cooperation with School of Agriculture, A. & M. College of Texas)

Observations of the dairy herd of the Feeding and Breading Station and of the dairy herd of the Department of Dairy Husbandry, A. & M. College of Texas, were continued during the year. The Feeding and

Breeding Station dairy herd has been established from a brucellosis infected herd by the double unit method and has been free of the disease since its establishment 10 years ago. There were 53 conceptions in this herd requiring 93 services. There was one case of abortion which was negative to brucellosis by the agglutination test and was probably caused by an injury.

In the clean dairy herd of the Department of Dairy Husbandry, two agglutination tests of all cows were run at six months intervals. On the first test run in June, two reactors and six suspects were reported. On a retest of the reactors and suspects in July no reactors and eight suspects were reported. On a second retest 30 days later no reactors and only two suspects were found and the reactors found on the June test now showed a clean test. All suspicious and reacting animals were removed from this herd and incorporated in the farm herd of the Dairy Husbandry department.

Simultaneously with the clean herd the farm herd was also blood tested. This herd is made up of all suspicious or reacting animals removed from the clean herd and has been carried as probably infected animals for four years. For the June 1941 test the herd was made up of 38 cows, 36 of which gave a negative test and two were reactors. One of these was destroyed, the other gave a positive reaction on the two subsequent retests but in December she was negative. This cow hed been negative during the two preceding years but suspicious before that. There were 150 conceptions requiring 216 services in the two herds combined, but eight cows were disposed of during the year as non-breeders. There were five abortions in the two herds combined during the year, but none of the aborting cows gave a positive reaction to Bang's disease and no other cause could be definitely incriminated.

Schmidt, Turk, Copeland, and Shepardson.

Trichomonad Abortion of Cattle

(In cooperation with School of Agriculture, A. & M. College of Texas)

No additional positive cases have been found in the A. & M. College dairy herd during the past year. Schmidt, Turk, and Shepardson.

Effect of Moldy Feed on Sheep and Other Farm Animals

Work on this project has been interrupted on account of lack of material from the field. No case reports were received during the year and no new material was available. Schmidt.

Swamp Fever in Horses and Mules

Work on this project has been suspended on account of lack of material but will be resumed when conditions and facilities permit.

Schmidt.

Loco Weed Poisoning

(In cooperation with Bureau of Animal Industry, USDA)

The experiment with blackstrap molasses was published in Progress Report No. 757. Blackstrap molasses did not prevent cattle from eating loco weed nor from becoming locoed when the weed was eaten.

Mathews.

Jimmies in Sheep and Goats

(In cooperation with Bureau of Animal Industry, USDA)

Jimmies in sheep and goats has been found to be due to the animals eating a poisonous fern, *Notholaena sinuata* var. *crenata*. A manuscript on this work has been submitted for publication. Mathews.

Poisonous Plants in the Davis Mountains

(In cooperation with Bureau of Animal Industry, USDA)

The work on red-stemmed peavine *Astragalus emoryanus* is being continued. This plant was collected from eight different localities, of which four were around Marathon, two around Van Horn, one around Sierra Blanca and one north of Alpine. The plant was found poisonous in only one of the eight locations from which it was collected, thus confirming results of previous feeding trials.

Whitebrush *Lippia ligustrina*.—Work on this plant was continued and a manuscript has been prepared for publication. The plant was found to be nontoxic to ruminants and one ass and quite poisonous to horses.

Peganum *harmalum*.—Feeding tests with this plant showed that it was somewhat toxic to cattle. It seems to cause a loss of appetite and during such periods as this condition is produced, this plant will not be eaten. If force fed, in spite of loss of appetitie, the plant will produce death in the animal.

Phyllanthus *abnormis*.—Feeding experiments with this plant have been continued during the year and additional evidence obtained that it is responsible for loss in calves. The toxic principle is excreted with the milk of the mother cow. Additional tests are necessary to clear up the whole problem.

Blackbrush *Flourensia cernua*.—The fruit of this plant were found to be poisonous to sheep. The green leaves of the plant do not seem to be poisonous. This plant caused heavy losses on one ranch.

Sand Sagebrush *Artemisia filifolia*.—This plant is suspected of causing abortion in cattle and an experiment has been planned and is now in progress Mathews.

Stiff Sheep

(In cooperation with Bureau of Animal Industry, USDA)

The condition in sheep reported last year and usually known as "stiff sheep" has not been encountered during the last year. Additional data are not available at this time. Mathews.

Pathological Conditions Accompanying Vitamin Deficiencies

Work on this project is going forward satisfactorily. A paper entitled, "Vitamin A Deficiencies In Ruminants," was published in the American Journal of Veterinary Research, Volume 2, No. 5, October, 1941, pp. 373-389. There is nothing essentially new to be added to the results recorded in this publication. The experiments are being continued. Schmidt.

The Role of Nicotinic Acid, Pantothenic Acid and Other Members of the Vitamin B-Complex in the Nutrition of Herbivorous Animals

(In cooperation with School of Agriculture, A. & M. College of Texas)

This project is a revision and enlargement upon the project originally entitled, "The Role of Nicotinic Acid in the Nutrition of Ruminants." Studies have been continued on six Shetland ponies with a diet deficient in nicotinic acid, pantothenic acid, and probably others of the B vitamins. On the basis of these studies evidence was obtained that pantothenic acid must be present in feed of horses. The data for nicotinic acid were inconclusive. The investigations are being continued to secure information on the need of the horse for other members of the vitamin B-complex. Pearson and Schmidt.

Testing Manufactured Feed Samples for Poisons or Other Substances

During the year one sample of manufactured feed was submitted to this division for testing. The test was negative. Schmidt and Fuller.

Mastitis Investigations

(In cooperation with School of Agriculture, A. & M. College of Texas)

Mastitis investigations carried on in cooperation with the Dairy Husbandry Department in the School of Agriculture, A. & M. College of Texas, in the farm herd, have been continued during the year. Fourteen infected quarters, eliminating *Streptococcus agalactiae*, were treated with trypaflavine with the result that the streptococcus was removed from the quarter. Eight quarters required one treatment, five required two treatments and one required three treatments with trypaflavine. Sixteen other quarters were given short-wave diathermy treatment with the result that after 60 treatments all quarters were still infected. The invesigations are being continued. Schmidt, Turk, and Darnell.

Miscellaneous Disease Investigations

During the year a disease heretofore undescribed was found in cattle in northeast Texas. The symptoms exhibited by the affected animals indicate a nervous disturbance, probably located in the brain. Cattle and sheep inoculated subcutaneously with brain emulsion from affected animals, and guinea pigs and rabbits inoculated subcutaneously and intracranially, failed to give us any clue as to the infectious nature of the trouble. If and when the trouble recurs, we expect to continue our efforts to find the cause.

Hemoglobinuria.—During the year a condition manifesting itself in hemoglobinuria, marked destruction of the red blood corpuscles, pronounced weakness and normal temperature, was found rather widespread in animals less than a year old but more frequently in animals less than six months old. Efforts to transmit the disease by inoculation of material taken from dead and sick animals failed to transmit the disease. Analyses of the local conditions under which the animals were kept, especially the manner in which they were fed and the kind of feed consumed, likewise failed to give us a clue as to the cause of the trouble. If and when the trouble recurs we expect to continue our efforts to find the cause.

A number of calls for help were answered during the year in which a condition of photosensitization of the animals, manifesting itself in widespread inflammation of the skin, followed by necrosis of the same, was found. It is known that the consumption of certain plants causes such a condition, but in none of the premises visited where the condition occurred could any known plants be incriminated. Schmidt.

WILDLIFE RESEARCH

(In cooperation with the Fish and Wildlife Service, United States Department of the Interior; the Agricultural and Mechanical College of Texas; the Texas Game, Fish and Oyster Commission; and the American Wildlife Institute)

Management of Wild Turkey Production in the Hill Country of Texas so as to Develop the Most Secure Source of Annual Income

Feeding stations have been established on the ranches of 10 cooperators. Since October 1941 each man has been feeding in an effort to hold the wild turkey population in the region. Selffeeders have been constructed (turkey laying pellets will be fed beginning about February 1 in the attempt to induce earlier laying). Attention is being given to potential predators, including the gray fox, skunks, raccon, and ringtailed cat, and more than 200 stomachs, mostly with intestines attached, have been collected. Taylor and Ramsey.

SUBSTATION NO. 1, BEEVILLE

Substation No. 1, 5 miles east of Beeville, Bee County, serves a large area of dark-colored fertile soils lying in South Texas. Goliad and Victoria soil types predominate in this region. A normal rainfall of 30 inches is fairly well distributed throughout the year, with more of it coming in the winter and spring months. Mild temperature, with few frosts, prevail; giving an average growing season of 288 days. Normally, second growth and fall-planted feed crops can be successfully matured. Green grazing can be had during almost the entire year. These factors combine to make this region admirably adapted to diversified farming with livestock as a base. The critical period for plant growth comes in the hot and dry seasons in July, August, and September. With these facts in mind, the station is turning more attention to findings and developing crops suitable for growing in the winter months.

Its activities consist chiefly of developing, testing, growing, and curing of feed crops and grasses, and utilizing them through beef cattle and sheep; and growing of profitable cash crops with which to complete a balanced system of agriculture. Some attention is given to the testing of trees and ornamentals for use in landscaping.

Feed Crops

Heavy rains began in the fall of 1940 and lasted throughout all of 1941. During the spring and summer rains were very frequent. This made crop production rather difficult and expensive. Insects and diseases were prevalent, thereby causing much damage to crops. Because of the wet soil it was impossible to keep down weed growth. Spring opened up early but because of continued cool weather, all crops developed slowly and were fully one month late in maturing.

Corn: Texas hybrids made an excellent showing. Five of the best ones gave an average increased yield of 34 percent over the old standard varieties. Texas hybrids Nos. 8 and 12 gave highest yields with 66 and 47 bushels, respectively. Ferguson's Yellow Dent, Surcropper, and Golden Thomas were the leading old standard varieties.

A corn date of planting test contained three varieties planted at four dates. Golden Thomas and Giant Yellow gave highets yields from March 1st planting. Surcropper gave highest yield from February 20 planting. A period of years summary indicates that March 10 to 15 is the optimum time for planting corn in this area.

Registered Golden Thomas is grown on the station for distribution to seed growers for the production of Certified planting seed. It is one of the most popular varieties for this area.

Sorghum: Grain sorghums are becoming more and more important as a source of feed in South Texas. Unfavorable curing facilities, weevil

damage, and high cost of harvesting by hand and storing have been large factors in retarding past production of grain sorghums. These difficulties are being overcome by use of trench silos for both forage and threshed grain and by extensive use of the combine in grain harvest. Some progress has been made in using the trench for curing combined grain. Several methods have been tested on the station. Indications are that the most practical is to dig trenches four to six feet deep and sufficiently wide and long to accommodate the herd to be fed. Line the trench with builders paper and fill it to within one foot of the ground level with freshly combined grain. Sprinkled with sufficient water to moisten thoroughly (50 to 60 gallons per ton of grain). Place builders paper over the grain and finish filling the trench with freshly cut or cured ensilage. Cover with about 6 inches of soil and leave until ready to feed.

Twenty-six varieties of sorghums and grasses were grown in a variety test. Excessive rains during the growing and harvesting seasons damaged part of the crop. Schrock kafir No. 37 gave the highest grain yields with 42.4 bushels per acre. Quadroon was second with 42.4 bushels. Atlas sorgo gave the highest forage yield with 7.83 tons dry stover per acre. A period of years summary together with general observations indicate that Texas Blackhul and Schrock kafirs are two of the best sorghums for early planting for grain. Hegari is the best for late planting. Atlas sorgo is especially adapted as an ensilage crop. Quadroon and Double Dwarf milo are excellent for early planting for quick feed. Wheatland milo and some new crosses, now being developed, are especially adapted to combine harvesting.

Fifty-six dwarf type sorghum hybrids were grown in the spring in test plats. In comparison with Hegari and Wheatland milo several of these made excellent showing. The most outstanding was Texas milo x Desert milo No. 7075-9-2.

Small Grain: Forty-four varieties and hybrids of oats were grown to develop a vegetative oat resistant to rust and adapted to this area as grazing and seed crop. Some strains showed remarkable rust resistance and gave fair yields. The Rustler oat bids fair to become very profitable in this area.

Forty-four wheat hybrids were grown for the purpose of studying their growth habits and resistance to rust. Some good yields were secured. A spring wheat nursery contained 132 selections was grown in an effort to find a vegetative high yielding wheat for this area. Some promising selections were found. One-half acre of wheat selection 41-16-3 made very excellent growth and fair seed crop, but was destroyed by excessive rains before harvest.

One-quarter acre of Giant Awnless barley made very rapid growth and some seed but was likewise ruined by rains before harvest.

Winter Legumes: Fifty-three strains and varieties of winter clovers and vetches were planted in a single rod row nursery. Because of excessive rains rather poor growth was secured. Several strains of Hubam clover showed superiority over the other plantings. Hubam clover continues to be the outstanding winter legume for this area.

Grasses: Fifty-two selections and varieties were planted in a grass nursery for the purpose of studying their growth habits in this locality. *Andropogon ischaemum* (Yellow Beard grass) and *Cenchius biflorus* (Spineless bur grass) were outstanding and will be increased. Other varieties show promise.

Rhodes grass made good showing wherever planted on the station and on farms. It continues to be the outstanding perennial planted grass for this area.

Because of excessive rains Sudan grass failed to give its usual outstanding results. Leaf spot seriously injured it throughout the growing season. Two Sudan hybrids from the Lubbock Station, Nos. 5325 and 5326, showed remarkable resistance to this leaf spot.

Cash Crops

Cotton: Cotton continues to be the most popular cash crop for this area. Excessive moisture throughout the season gave abnormal vegetative growth. Fleahoppers, boll weevils, and leaf worms were numerous. By heavy dustings these were held in check and a fair crop was matured.

Thirty-six varieties were grown, and the highest yield of 250 pounds of lint cotton per acre was made by Deltapine 14. Stoneville 2B came second with 236 pounds; Ambassador and Washington tied for third place with 235 pounds.

In a period of years summary of all varieties grown four or more years, Mebane 804-50 continues to give the highest yields.

A cotton date of planting test included Lankart and Mebane 804-50 planted at 10-day intervals from February 20 to April 1. Mebane 804-50 gave the highest yield from the February 20 planting. Lankart's highest yield came from the March 1st planting. A period of years summary continues to give highest yields from February 20 planting for Mebane 804-50. The high yield of Lankart comes from March 1 planting.

Broomcorn: Broomcorn continues to be second in importance as a cash crop in this area. Only dwarf varieties are grown. Texas Scarborough Dwarf, developed by the station, is one of the best varieties. Registered seed are produced on the station and distributed to cooperating farmers for the production of State Certified seed. Very poor seed yields were made during 1941. A good crop of straw was produced, but much of it was badly damaged by rains during harvest season.

Flax: Excessive rains during November 1940 delayed planting of the flax crop. Continued rains throughout the growing and harvesting season did much damage. Bison was almost ruined by rust and made very poor yields. Rio and Bolley's Golden varieties made fair yields. Most of the crop seeded in the fall of 1941 was planted to these varieties.

Soybeans: A spring nursery containing 167 varieties and hybrids was planted in March. About 30 of the earliest of these, produced some mature seed, but only a few gave yields to make them of commercial importance.

A fall planting made in September contained 31 varieties. Again several varieties produced some mature seed but because of unfavorable weather and other factors, plants were very small and yields were low.

Castor Beans: A spring planting contained seven varieties of castor beans. Fair vegetative growth was made but no fruit was set until late fall. The unripened fruit was killed by a very late frost. Castor beans give no promise of success as a commercial crop in this area.

Fruits and Ornamentals

Fruits: All citrus trees made a remarkable recovery from the past two years' of severe set-backs. Satsumas produced a good yield of high quality fruit. Meyer lemons also gave a fair yield of excellent fruit. Round oranges and grapefruit gave light yields, but fruit was of excellent quality. Ranger strawberries planted in December 1940 gave a high yield of very excellent fruit.

Shade Trees: Hackberry, mesquite, and huisache continue to be the leading shade trees for this area. Chinese tallow is making a good showing on the station. Ash is used quite extensively in the heavier soil areas. Cotton root-rot injury limits the use of Chinese elm.

Tamarix, California and Amur River privets, senisa, agarita, and Pyracantha have proven valuable for hedges and for basal plantings. Many other native shrubs are being used. Hall and Neal.

Hegari Stored in Trench Silos as a Feed in Fattening Beef Cattle

Ensiling threshed grain in a trench silo is a very cheap and convenient method of handling combine harvested grain sorghum. To determine the comparative feeding value of trench cured grain with that stored under normal barn stored conditions, 30 well bred Hereford calves were placed on feed in December 1940. A chemical analysis showed each of the differently cured grains to have approximately the same food constituents and productive therm values. Based on results of this test, indications are that grain well cured in trench silos loses little, if any of its feed values. Losses from spoilage and otherwise in this test were very high. Tests are being run to determine more efficient methods of trench curing of grain. Hall, Jones, (J. M.), and Neal.

South Texas Grown 37 Percent Protein Linseed Meal vs. 43 Percent Cottonseed Meal in a Beef Cattle and Lamb Fattening Rations

Beef cattle fed 2 pounds per head daily of 37 percent protein linseed meal was compared with a similar amount of 43 percent protein cottonseed meal, as protein supplements for fattening during a 153-day feeding period. Ground threshed Hegari grain, Atlas silage, and ground stover, respectively, were fed in similar amounts in each of the lots. There were no significant differences in the response of the cattle to these feeds. The linseed meal group, basis market weights, showed an average daily gain of 2.25 pounds per head as compared with 2.12 pounds for those fed cottonseed meal. The group fed cottonseed meal on the other hand had a slight advtange in carcass grade.

Lambs fed each of these protein supplements at the rate of 34 pounds per head daily with cracked shelled corn, Atlas silage, and Red Top cane hay during a 96-day period, the average gain was .30 pound per head daily for both groups on the basis of market weight. The results for both supplements were satisfactory.

Jones, (J. M.), Hall, Neal, and Jones, (J. H.).

Blackstrap Molasses in a Beef Cattle Fattening Ration

Three pounds of blackstrap molasses as replacement for a similar quantity of good quality ground threshed Hegari in rations during a 153-day period of fattening calves which weighed around 420 pounds at the beginning of the test resulted in lowered gain and lower carcass grade. Basis market weights, the check group showed an average daily gain per head of 2.12 pounds as compared to 2.04 pounds by the group in which molasses replaced one-fourth of the grain.

Jones, (J. H.), Hall, Neal, and Jones, (J. M.).

Hegari versus Corn in a Laying Ration for Hens

A group of 100 pullets in their first laying year were divided into two equal pens of 50 birds each, and placed on a home-mixed laying ration on January 10. Both pens received identical rations, except that Hegari meal for the mash and whole Hegari grain as a scratch in one ration, was replaced with corn meal and cracked corn in the other. The test was closed on October 9. The corn fed lot consumed 26 percent less mash and 9 percent more scratch feed than did the one receiving Hegari. The corn fed lot laid 2 percent less eggs than did the Hegari lot. Sixteen hens were lost out of the corn lot, while 12 died from the Hegari lot. These data indicate that there is no significant difference in the feed value of corn and Hegari in a ration for laying hens.

Sherwood, Couch, and Hall.

Growing Turkeys Under Semi-Confined Conditions

A flock of poults furnished by the Division of Poultry Husbandry were grown in a one-acre pen. An accurate feed record was kept to determine

the feasibility of growing turkeys under semi-confinement in South Texas. The poults were started under coal oil brooder on commercial starter feed. They were fed home-mixed rations from self-feeders for the remainder of the test. A mortality of 17 percent was suffered. The average for the area was 50 to 60 percent. At the end of eight months the toms weighed an average of 31.5 pounds and the hens weighed 17.1 pounds. All were finished for market. The total cost, exclusive of labor and interest, was 9.05 cents per pound. They were sold on the local market at 18 cents and 20 cents or 2 cents above market price. These figures indicate that turkeys can be profitably grown under semi-confinement in this area. Sherwood, Baker, and Hall.

SUBSTATION NO. 2, TYLER

Substation No. 2 is located ten miles northwest of Tyler and five miles southeast of Lindale, Smith County, on Highway No. 69, and is operated in cooperation with the Soil and Water Conservation Experiment Station of the Soil Conservation Service, U. S. D. A. The soils of this region are predominantly fine sandy loams of the Kirvin Bowie, and Nacogdoches series, with smaller areas of other series.

The average annual rainfall for the past 37 years has been 43.32 inches. During 1941, the annual rainfall was 54.95 inches, of which 28.39 inches fell during the five months May to September, inclusive, as compared to the average of 16.13 inches for the same normal period. This excessive rainfall contributed to great difficulties in cultivating the various crops, made ineffective the insect control measure, and promoted the spread of plant diseases.

The principal problems of this station deal with (1) conservation, maintenance, and increase of fertility, (2) the production of various agronomic and horticultural crops, (3) the pathological aspects of rose culture, and (4) the production through breeding and selections of better adapted crops.

Agronomic Investigations

Variety Tests

Cotton: Hibred, Miller 610, and Deltapine 14 were the highest producing cotton varieties in a test that suffered heavily from boll-weevils, bool worms, and other factors unfavorable to good yields. Considering only those varieties grown for three years or more, the highest averages have been made by Rogers Acala, Hibred, Half and Half, and D.&P.L. 12. Rhyne's Cook has been the best variety on soil infested with wilt and root knot nematodes.

Corn Varieties and Hybrids: Eight Texas named hybrids produced an average of 21 percent more than ten commercial varieties. Other experimental hybrids equaled the performance of the named hybrids. Out-

of-state hybrids produced more than the commercial varieties, but not as much as the Texas hybrids. Soil and moisture conditions of the test were favorable for corn and better than average yields were obtained.

Soy Beans: In a test of over 200 varieties of soy beans, only one variety yielded in excess of 10 bushels per acre. The Mingo variety produced 14.7 bushels per acre, while the rest ranged from 9.6 to 0 bushels per acre. Forage yields ranged from 0.8 to 4.8 tons per acre. The results obtained with soy beans at this station indicate that they can be used as a forage crop, but cannot be depended upon for profitable seed production.

Castor Beans: Yields of castor beans were very low ranging from 12.7 pounds per acre for the Common variety to 130.9 pounds per acre for the Flowering variety. In a non-replicated supplementary test, Doughty's No. 11 produced 255 pounds and San Benito produced 314.7 pounds of threshed seed per acre. The low yields were caused by excessively wet soil during part of the season and attacks by "stink bugs."

Crop Improvement

The 1941 season was a most difficult one for crop improvement work because of the insect damage favored by climatic conditions.

Texas Seeded Ribbon Cane: Only a few bagged heads produced sound seed because of molds and insects. Insects destroyed most of the open pollinated seed before it matured. Only a very small amount of seed was harvested. Sufficient remnant seed from last year is on hand to continue the work.

Cowpeas: An attempt to increase seed of desirable strains of disease-resistant Blackeye cowpeas resulted in a complete failure because of "stink-bug" insects and molding due to excessive rains at harvest time. Some seed of a few strains were saved. Work was initiated on the incorporation of disease-resistant factors into the Cream variety.

Cotton: Breeding for the production of a better quality cotton variety resistant to a combination of wilt and nematodes was continued. Seed production was very low because of insect damage.

Corn: Large quantities of selfed seed of Texas inbreds Nos. 102A and 158-4 were produced as well as reciprocal single crosses of these two inbreds.

Soil Fertility Studies

Cotton and Corn: Hairy vetch, fertilized with 400 pounds per acre of and 0-8-4, used as a green manure crop preceding cotton, continued to be the most profitable fertilizer for cotton and corn in a two-year rotation. The soil used for cotton this year was too wet during much of the growing season and development and fruiting was slow. Insects

further reduced the yields. Without further applications of fertilizers the residual effect of this treatment the second year when planted to corn, produced 26.4 bushels per acre as compared to 11.5 bushels on unfertilized soil.

Cooperative Potash Studies: An experiment was started in cooperation with the American Potash Institute to obtain additional information on the use of potash on certain crops in this area. Three cooperative tests with cotton, two with cowpeas, and one with corn were conducted during this season.

The use of potash under cotton showed an increase in some cases. The yields in all cases were very low and a true expression of the effects of the various treatments was not obtained because of unfavorable weather conditions.

Pasture Grasses: This year the yields were approximately double those of last year due to excessive rainfall. Additions of nitrogen, phosphoric acid, and potash have increased the yields of pasture forage, but nitrogen and phosphoric acid have been more effective than potash. The forage is almost entirely grass, no legumes are included.

Dairy Cattle

No measurable differences in milk production were obtained from the addition of lime to the ration of lactating cows. Some indications of better health and vigor of those animals receiving lime were observed, but whether this was due to factors other than the lime could not be determined. Johnson.

Rose Investigations

Culture Experiments: Results of the 1940-41 experiments indicated, as in previous years, that the greatest response in wood growth resulted from increments of nitrogen. A 12-9-3 fertilizer used at the rate of 600 pounds per acre gave the heaviest plants. A 6-9-3 fertlizer though producing less growth was judged to be the better fertilizer inasmuch as the wood was riper at time of harvest. Lime mixed with either 12-9-3 or 6-9-3 where ammonium sulphate was the nitrogen carrier induced early dormancy and resulted in hard wooded plants. Magnesium sulphate appeared to have a beneficial effect on plant growth. Plants receiving no cultivation but shallow hoeing did as well as plants receiving regular sweep cultivations.

Understocks: Tests at Tyler, Greenville, Denton, and Weslaco have indicated that the Multifloras are generally more satisfactory as understocks than Texas Wax and Odorata.

Soil Acidification: Results of a four-year study of the effect of soil acidification have shown that rose bushes make somewhat better growth at a pH of 7.5 to 7.8 than at a pH of 7, which is close to the neutral

point. As the pH is further decreased, growth of the plants gradually increases. At a pH of 5.5 growth is substantially better than in alkaline soils.

Spring Pruning of Roses: Results of the 1941 pruning tests confirmed those of 1940, namely, the more severe the spring pruning the less the number of blooms produced during the following season. Results further indicated that while the percentage of long stemmed blooms is less, the actual number is greater on lightly pruned plants than on severely pruned plants.

Dried Rose Blooms: The possibility of drying rose blooms for sachet use was studied. Results indicated that blooms from Tyler rose nurseries could replace those formerly imported from France. It was found that the brilliance and stability of color of red and pink rose buds could be improved by treatment with fumes of hydrochloric acid. Ratsek.

Rose Diseases

Black Spot Disease: The 1941 season was extremely wet which favored the occurrence of the black spot disease with its subsequent defoliation, stunting, and die-back.

In tests of fungicides to control black spot, the sulfur-copper mixture again were more effective than sulfur alone. These included mixtures of copper materials and various sulfurs with and without sticking agents (bentonite and flour); also coppers were tried with diluents other than sulfur with and without sticking agents. The season was such that foliage burning and injury were not apparent from any of the fungicides tried.

The principal result was that unconditioned 325 mesh sulfur proved as suitable in combination with certain coppers as mixtures containing conditioned 325 mesh sulfur. However, lumping when stored and sticking inside dusters occurred with two kinds of coppers when utilized with unconditioned sulfur. Bentonite and wheat flour stickers gave variable results and could not be recommended for dust fungicides from the experiments of this year. A sulfur and basic copper sulfate mixture which was prepared at the first of the season appeared to give as good results as mixtures freshly prepared for each application. Dusting within twenty-four hours after each rain gave the best results. The most economic frequency of dusting was weekly after black spot appeared until July 1 and biweekly thereafter until October.

The copper materials which appeared most suitable were: Tennessee Copper 34, Cuprocide GA, Cupro-K, Copper Oxychloride Sulfate, Spray-Cop, Zinc, Coposil, Copper Hydro 40, and Dow Bordow.

Increase in weight of bushes as much as 75 percent proved the value of the sulfur-copper dust treatment, substantiating the results of previous tests.

The immunity of the Welch strain of Rosa multiflora understock from nfection with true black spot *(Diplocarpon rosae)* continued to be evidenced nroughout the season.

Die-back Disease: Die-back of the Diplodia type was observed in many ose fields. Even in some of the dusted plats, the variety Caledonia was everely affected. It occurred the least where the best control of black pot was obtained.

Crown Gall and Hairy Root Diseases: Experiments to control crown all by treating rose cuttings with protectants before planting showed nat mercurials were quite effective. Cuttings soaked ten minutes in emesan (1:400) solution showed a good live and good control of the isease. Other mercurials which appeared favaroble were Semesan Bel 1:60) dip, corrosive sublimate (1:1000) 20 minute soak, and calomel 1:33) dip. A dust mixture of 2 percent Ceresan and talc in a 1:9 pro-ortion gave very promising results. Dusting cuttings with 325 mesh ulfur allowed excellent live but gave little or no control of crown gall.

Rotation of crops in an infested area with Iron cowpeas, oats and rotalaria grown for two years between crops of roses effected a reduc-on of approximately 50 percent in infection with crown gall.

Cuttings taken from plants with roots infected with hairy root (closely elated to crown gall) were shown not to carry the bacteria systemically. lantings made with such cuttings failed to develop the disease.

Root Knot Nematode Disease: The immunity of the understock hybrid *osa multiflora* x *R. blanda* from root knot nematode *(Heterodera marioni)* ntinued to be evidenced during the 1941 season.

Rotataion of crops with two years out of roses was ineffective in re-ucing the root knot disease. In the same area as described under crown all control test, two years in Iron cowpeas, oats, and crotalaria between ops of roses resulted in an increase in the amount of root knot nematode fection from 80 to 100 percent.

Streak Disease: The virus disease known as streak was found to be ansmitted in all cases where budding was done with infected C. K. ouglas variety. Other varieties previously tried failed to show complete ansmission.

Lyle.

Soil and Water Conservation Investigations

n Cooperation with the Conservation Experiment Stations Division of the Soil Conservation Service, U. S. Department of Agriculture)

The results of the experiments of the soil and water conservation studies the Tyler station are applicable to an area of approximately 33 million res in eastern Texas, southwestern Arkansas, and northwestern Louis-na, which are the rolling sandy lands of the Interior West Gulf Coastal

Plains. The area is one of the most seriously eroded areas in the United States.

The chief aim of the soil and water conservation studies at the Tyler station is to develop better methods of conserving the topsoil and the maintenance and improvement of its fertility. The principal work engaged in to date has been the measuring of surface run-off and soil losses in run-off from control plots, terraces, and field areas under different conditions. The effects on soil and water losses of such factors as crop rotations, plant cover, degree of slope, slope length, soil series, burning of woods, land use and treatment of small watersheds, and terracing (including grade, spacing, and length) are being studied.

Crop rotation. The effect of crop rotation on surface run-off and soil losses in run-off, as indicated in this study, depends largely on the amount of protection afforded by the crops included in the rotation at the season of the year when the erosive rains occur. No outstanding accumulative effects of erosion resistance have been noted in the study which could be attributed directly to the residual effect of the preceding crop.

A three-year rotation of cowpeas, cotton, and sorghum with a winter cover crop of vetch in comparison with continuous cotton without a vetch cover crop on Kirvin fine sandy loam of 8.75 percent slope over a period of five years reduced the soil losses 39 percent.

A three-year rotation of corn, cotton, and oats with a winter cover and green manure crop of vetch following the corn and preceding the cotton with oats following cotton, a summer green manure crop of peas following the oats, and oat cover crop preceding corn in comparison with continuous cotton with a vetch cover crop over a period of two years has reduced the soil loss 27 percent. This reduction resulted chiefly from the low soil losses from the oat crop in the system.

Plant cover. Plant cover is one of the most important factors in the control of erosion. The type of vegetation on the land at the time of the storm determines to a large degree the amount of soil which may be lost from the storm. Dense vegetation reduces soil and water losses by intercepting the rainfall and breaking its force. It prevents the run-off from becoming muddy, thus preventing the clogging of pore spaces and permits greater infiltration. Plant cover also obstructs and retards the flow of surface run-off, thereby reducing the cutting power.

Degree of slope. The degree of slope determines mainly the kind of crop which may be successfully grown on an area without excessive soil losses resulting from cultural methods necessary in the production of the crop. Over a period of years, cotton produced on 8.75 percent slope Kirvin and 16.50 percent Kirvin has resulted in an increase of two and one-half times more soil loss per acre on the 16.50 percent slope; whereas, Bermuda grass sod on the two slopes has not shown any material differences in the percentages of surface run-off and soil losses.

Length of slope. The length of unprotected slope over which run-off flows is an important factor in the amount of soil loss the production of crops requiring intensive cultivation. The result over a period of years have shown a definite increase in soil loss on 8.75 percent slope Kirvin with an increase in unbroken slope length. An increase in slope length has not shown any material differences in percentages of surface run-off in this study.

Soil series. It is recognized that some soils of the area are more erodible under similar cropping treatment than others. Kirvin and Nacogdoches, two important soils of the area, are included in this study. The results over a period of years where topsoil and subsoil of both series have been cropped continuously in cotton with similar cultural treatments show the average losses from Kirvin on 8.75 percent slope have been three times greater per acre than Nacogdoches on a 10 percent slope under the same crop and cultural treatments.

Burning woods. The results over a period of years have shown that burning of woods annually increases both soil and water losses. These losses have increased from year to year. The burned area over a period of ten years has lost an average of 714 pounds of soil per acre and 2.61 percent of total rainfall as surface run-off; whereas, the area protected from burning has lost only 91 pounds of soil per acre and 0.34 percent of total rainfall as surface run-off during the same period.

Small watersheds. A wooded area, a contour-cultivated, a strip-cropped, and recently a permanent pasture watershed are included in this study. The two cultivated watershed continue to give high soil losses with an increase in the number as well as the depth of the gullies. The results seem to indicate rather definitely that neither contour cultivation nor temporary annual strip cropping alone in this area is a satisfactory erosion-control measure. The wooded area protected from fire and grazing continues to increase in effectiveness against surface run-off and soil loss. The permanent pasture watershed now under measurement will furnish additional surface run-off data and increase the value of the watershed studies for this area.

Terracing. All terraced areas continue to perform satisfactorily. The open end, level, and minimum graded terraces again demonstrated their ability to conserve soil and water without seriously damaging crops or delaying timely cultural operations due to ponding of water in the terrace channels.

Pope and Archer.

SUBSTATION NO. 3, ANGLETON

Substation No. 3 is located 3.1 miles northeast of Angleton, Brazoria County, with an elevation of 23 feet above sea level. The station is located in the Gulf Coast Prairie region and the soils are of the Lake Charles and Edna series. The topography is flat with slow drainage. The average rainfall over a period of 28 years was 46.50 inches as compared with 70.88 inches for 1941.

The year 1941 was the wettest on record at this station. A tropica storm on September 24 destroyed or seriously damaged the crops in th field and ruined the most of the experimental work for the year sinc only a few of the tests had been completely harvested at that time. Th wind velocity during the storm was estimated at 90 miles per hour. Onl the tests on which reliable data were secured will be discussed in this re port.

Corn: The spring of 1941 was unusually cold and the corn made very slow and spindly growth. The corn variety and hybrid yield tes contained fifteen commercial varieties, nine named Texas hybrids and 3 other hybrids from Texas and other states. The best named Texas hy brids produced 18% higher yields than the average of the best com mercial varieties. Texas hybrid No. 3-W produced 33.0 bushels of shelle grain per acre and Texas hybrid No. 6 produced 31.8 bushels per acre These were the highest yielding named Texas hybrids in the test. As group the northern hybrids did not produce as good yields as the bes Texas Commercial varieties. For the past ten years Surcropper has pro duced an average yield of 24.2 bushels per acre as compared with Mexica June with 23.8 bushels, Reese Drouth Resister with 23.2 bushels an Tuxpan with 21.7 bushels. These are all recommended varieties for thi section. The first three named are early varieties and Tuxpan is a lat variety.

Flax: The flax variety test was a failure this year due to the stand being destroyed by continued wet weather.

Soybeans: One hundred ninety-six varieties and strains were grown i 1941 for data on seed production. The vegetative growth was satisfactor but the seed yields were a failure. Only a few varieties produced an filled pods although most varieties produced an abundance of pods.

Winter Legumes: The winter clovers made a good growth during th winter in spite of the wet weather. California Bur clover produce 2.45 tons of air dry forage per acre as compared with 3.91 tons fo Temple hubam, 1.17 tons for Melilotus indica, 2.34 tons for Orego vetch, 2.24 tons for Idaho Red Clover and 1,11 tons for Crimson clove The alfalfa, fenugreek and various winter field peas made much lowe forage yields. However, the California bur clover, Hubam clover, an fenugreek made good seed yields. The California bur clover produce 960 lbs. of seed in the bur per acre and fenugreek produced 1080 pounds All the vetches were severely damaged by mildew in the spring an produced no seed.

In a comparison of four varieties of winter legumes grown on bedde and flat land, and with and without 40 pounds of phosphoric acid pe acre, the phosphoric acid has produced higher yields of all the legume tested. The value of bedding is doubtful.

Pastures: In a pasture fertilizer experiment started in 1936 on carpe grass sod, phosphoric acid was applied at the rates of 40 and 80 pound

per acre alone and in combination with 20 and 40 pounds of nitrogen per acre each year. In 1941 the increases in yield from these treatments ranged from 61% to 86% over the yield of the untreated soil which was due largely to the phosphoric acid and not to the nitrogen. No clover was ever seeded on these plats but white clover began to volunteer on the phosphate plats by the third year. Undoubtedly, the increases in yield obtained this year are due largely to the luxuriant growth of clover brought about by the application of phosphate.

Horticultuarl Work

With the exception of figs most of the horticultural crops at this substation were a failure because of adverse weather conditions. A tropical storm in September blew the pecans from the trees and did considerable damage to the fig orchard. The repair and replacement of damaged fig trees has proceeded throughout the season. A good start of Meyer lemons was obtained from cuttings and these will be set out in orchard form this year. Reed (H. M.)

Fig Breeding Work

Pollination tests to confirm the work of last season were abandoned after the storm had severely damaged those figs which were already pollinated but not matured and had put an end to further production for the season. Reed, (H. M.), and Yarnell.

Fig Products Investigations

Approximately 70 varieties of figs produced mature fruit this year. Yield data are incomplete because the storm brought an end to production on many of the varieties before the end of their season.

The quality of the dried figs was poorer this year than last, and the drying ratios were considerably higher. With most of the varieties the quality of the fruit decreased and the drying ratio increased as the season advanced.

The best lye peeled preserves were made from Smyrna x Maslin capri with a quality rating of good to excellent followed by de Grasse with a rating of good. The best unpeeled preserves were made from de Archibel with a quality rating of good to excellent followed by Smyrna x Maslin capri, Martinique, and de Grasse with quality ratings of good. Ramsey and Pauly No. 2 made the best breakfast figs with quality ratings of good followed by a number of other varieties with ratings of fair to good.

Considerable interest was shown in the freezing storage of figs this season and one commercial interest started production on a small scale. Reed (H. M.)

Grape Products Investigations

With the present market value of cream of tartar the recovery of tartrates from grape juice has become a worth while enterprise. The percentage of recovery from Carman grape juice was .52% by weight.

Concentrates made from Carman, Virginia and America juices under vacuum were of good to excellent appearance. There was not much flavor in the Carman concentrate but that made from Virginia and America juices had a good flavor. Carman and Virginia were concentrated to 65° Brix but the America was so viscous that it was necessary to finish it at about 56° Brix.

Jelly tests made on Delaware, Beacon, Black Spanish and Fern Munson had a quality rating of good based on appearance, consistency and flavor and 4 additional varieties had quality rating of from fair to good.

Nine samples and a sample of commercial Concord juice have a quality rating of from good to execellent. These include 4 of last year's formulas and 5 new ones: 50% Carman to 50% Virginia acidified with citric acid to 1.24%; 50% Le Noir to 25% Delaware to 25% Catawba; 50% America to 50% Concord; 75% America to 25% Concord; 90% America to 10% Concord. The blends of America and Concord were better than America or Concord alone.Variation of the acid to astringency ratio from 4 to 5.4:1 and the Brix to astringency ratio from 107 to 141:1 had no significant effect on the quality of the juice. The addition of citric acid to increase the acidity resulted in a better quality juice than increasing the proportion of the high acid Mustang in the mixture.

Juice characteristics of 115 varieties of grapes which matured from July 9 to September 25 at the fruit laboratory at Montague were studied.

Reed (H. M.) and Randolph.

Anaplasmosis in Cattle

Heavy losses from anaplasmosis occurred during 1941 continuing late into the fall. These most probably must be ascribed to the great prevalence of blood-sucking flies and mosquitoes, as well as the extensive and repeated vaccinations for anthrax in susceptible herds which contained some carrier animals.

Three transmission experiments in which a number of different species of blood-sucking flies were allowed to feed first upon a susceptible animal failed to transmit the disease. Larvae hatched from eggs deposited by the lone star tick and the gulf coast ear tick, which had been taken fully engorged from a clinical case of anaplasmosis, failed to transmit the disease.

Intraveonus injections of mercurochrome up to maximum safe doses have not shown any specific value in the treatment of the disease.

Protein-tyrosin applied to serum and plasma to detect carrier animals have not been reliable in the modifications used.

Piercy and Schmidt.

The Relationship of the "Gulf Coast Ear Tick," *Amblyomma Maculatum*, to Screworm Infestation in Livestock and Methods for Its Control

Few Gulf Coast ticks, *Amblyomma maculatum*, have been observed during the year. Experiments showed that frequent and excessive rainfalls are detrimental to the ticks. No cases of screwworm infestation resulting from infestation with the Gulf Coast tick have been reported.

Piercy, Woodhouse, and Schmidt.

Keratitis of Cattle

Keratitis or "pink eye" was observed to occur during all months of the year. Our experiments have shown it to be infectious and that infection can be established with eye and nasal discharges when these are instilled into the eye or into the nose. This material is most infectious during the first 4 or 5 days after infection has been established. No immunity seems to follow an attack of the disease. Subcutaneous, intradermal or intravenous injection of infectious material was not followed by an attack of the disease. Cultures of the infective agent have not not yet been obtained. Epithelial cells of the conjunctive have consistently shown small intracellular bodies resembling Rickettsia.

Reid and Schmidt.

Toxemia Among Cattle of the Gulf Coast Area of Texas

Work on this project has been interrupted due to the lack of necessary field material. No definite outbreaks of this condition were encountered during the year in this area, therefore no new material was available for further study Reid and Schmidt.

Investigation of Gastro-Intestinal Parasites in Cattle

The examination of cattle viscera collected during the year from field cases of parasitic gastro-enteritis indicated that the small species of stomach worms, *Ostertagia ostertagi* and *Trichostrongylus axei*, the hookworm, *Bunostomum phlebotomum*, and the nodule worm, *Oesophagostomum radiatum*, are the principal nematode species of pathogenic importance in the Gulf Coast area. Although the large stomach worm, *Hae monchus contortus*, was observed as a severe pathogen in several sheep autopsied during the year, it did not occur in sufficient numbers in the cattle viscera examined to be of major importance. The months of the first and fourth quarters of 1941 were the most important from the standpoint of parasitic gastro-enteritis in cattle of the Gulf Coast area. The most requests for diagnostic assistance and the heavy infections occurred in those months.

Phenothiazine was employed as an anthelmintic, under field conditions, in a number of cases of parasitic gastro-enteritis in cattle. Although ex-

cellent results were observed in some cases, disappointing results occurred in others. A marked reduction in the percent volume of packed red blood cells was observed in several cases following phenothiazine therapy. One of the cases which terminated fatally, the percent volume of packed red blood cells dropped from 26%, prior to phenothiazine therapy, to 15.5% just prior to death, two weeks later. Further observations are being made with regard to probable intoxication resulting from phenothiazine therapy in cattle, under certain conditions.

A fenced and leveled plot has been infected with the larvae of cattle nematode parasites. The plot will be checked for survival of infective larvae in July, 1942 after being free of all livestock for one year.

Four attempts to experimentally infect parasite-free lambs with infective nematode larvae from bovine sources, were negative. These results would indicate that the ovine cannot be satisfactorily utilized as a test animal in bovine gastro-intestinal nemathelminthiasis.

Woodhouse, Reid, and Schmidt.

SUBSTATION NO. 4, BEAUMONT

This substation is located six miles west of Beaumont. The 100 acres of land is largely Lake Charles and Crowley clays which are representative soils of the rice-growing region. The main objective of the station is to help solve the problem of the rice industry in Texas.

The rainfall of 80.69 inches during the years was 23.08 inches above normal. These frequent and heavy rains were very unfavorable to all crops on this substation. This condition hindered the preparation, cultivation, and harvesting of crops.

Rice Investigations

(Cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture)

Frequent rains throughout the growing season proved quite unfavorable to rice production in 1941, and growers experienced considerable difficulty at seeding and harvest time. Lower than average yields were produced in all varietal experiments this year.

In the test of replicated field plats, the experiment included 14 of the most promising hybrid selections from the crosses Colusa x Blue Rose, Edith x Blue Rose, Improved Blue Rose x Fortuna, Kameji x Blue Rose, and Rexoro x C. I. No. 5094.

In the advanced nursery the highest yield was produced by an Improved Blue Rose x Fortuna selection. Other promising selections grown were from the crosses Edith x Blue Rose, Colusa x Blue Rose, Improved Blue Rose x Fortuna, Kameji x Blue Rose, Rexoro x Fortuna, and Rexoro x C. I. No. 5094.

In the premliminary yield nursery tests selections from the crosses Shoemed x Nira and Rexoro x Nira appeared to be most promising. These selections resemble Nira, except that they have shorter straw which is highly desirable. Several non-shattering, long, slender grain selections from the cross Kameji x Rexoro were grown, and also a large number of Blue Rose types rsistant to Cercospora leaf spot that were selected from crosses in which one of the parents was Blue Rose.

In the breeding nursery the most promising lines selected are as follows: Edith x Fortuna, B283A3-4-5; Kameji x Honduras, B2911A-18-1-1; Kameji x Blue Rose, B2912A13-2-2-1-1; Kameji x Blue Rose, B2912A47-1-1-1-1; Colusa x Blue Rose, B2913A29-1-1-1; and Edith x Blue Rose, B2916A34-3-3-1.

The selection Colusa x Blue Rose, B2913A29-1-1-1, is a heavy yielding early maturing variety with a grain shape and texture similar to Blue Rose, and the selection Kameji x Blue Rose, B2912A47-1-1-1-1 also has a grain shape and texture similar to Blue Rose, but when sown as early as April 15 matures about 10 days earlier. These selections will be grown in outlying field tests in 1942.

Fertilizer Tests: Rates and Combinations—The results in this test were in accord with those of former years in that phosphoric acid alone was of very little value, but nitrogen produced satisfactory increases in yield of rice with the increase being in proportion to the quantity of fertilizers used. The largest yield recorded was from the application of 200 pounds of sulphate of ammonia and 100 pounds of superphosphate per acre. However, ths increase of 1050 pounds per acre was only slightly more than was produced by the sulphate of ammonia alone.

Methods of Applying Fertilizers to Rice: Applying nitrogen on top of the soil increased the yield of rice 24 percent, and 35.5 percent when drilled in with the seed. A combination of nitrogen and phosphoric acid increased the yield 32.2 percent when applied on top of the soil, and 50.9 percent when drilled in with the seed. Phosphoric acid alone was of very little value in either case.

Cooperative Fertilizer Tests: The cooperative work was confined to Jefferson and Orange Counties this year. A combination of nitrogen and phosphoric acid in the Jefferson County test increased the yield of rice 65.6 percent. This was noticeably more than was obtained by using either nitrogen or phosphoric acid separately, however, adding the trace elements to the combination increased the yield 93.9 percent. The yield data in the Orange County test are of very little value due to the amount of straighthead present. The use of nitrogen appeared to increase the amount of this disease. The most striking result was the fact that the use of the trace elements appeared to have resulted in a marked decrease of the disease.

Sulphur on Rice Soils in Cylinders: This study of the toleranec of rice plants to different degrees of acidity and alkalinity was begun in 1937.

No lime or sulphur has been added to the soil since the beginning of the test. The readings at the time of planting this year varied from pH 4.0 to pH 7.0. In most cases the soil that was treated with lime to get pH readings of 7 and 8, has shown a noticeable drop since the beginning of the test. The yields of both grain and straw continue to show a gradual decrease each year, but in 1941, as in former years, the largest yields were obtained from the soil with the lowest pH and the smallest yields from those having the highest pH readings.

Cultural Tests: Rates of Seeding—Rexoro and Blue Rose varieties were each seeded at rates of 60, 80, 100, 120, and 140 pounds of seed per acre. Four replications were seeded without fertilizer, and four replications were fertilized at the time of planting. Where no fertilizer was used, the 100-pound rate of Rexoro produced the largest yield. Where fertilizer was applied to the Rexoro, the yield increased slightly with each increase in rate of seeding.

Rotations: The yields from the plats that have been cropped to rice continuously for the past 11 years showed a noticeable drop this year. The yields were approximately as large as usual on all of the plats that have been used in the various two-year rotations. None of the two-year rotations used has permitted the satisfactory control of weeds and grass.

Variety and Date of Seeding: This test is designed to include seedings at 20-day intervals from March 20 to June 10. The results continue to show that plantings made as late as June 10 produce lighter yields than seedings made between April 10 and May 15. Wyche.

Diseases of Rice

(Cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture)
Edgar C. Tullis, Pathologist

The leaf spot fungi, *Helminthosporium oryzae* and *Cercospora oryzae*, were most common on rice in Texas in 1941. Very little rotten neck or kernel smut was observed. Considerable straight-head occurred in the Beaumont area but less than for the previous year in other rice-growing sections.

Plantings of rough rice of the Blue Rose, Rexoro, and Acadia varieties used in a storage experiment, were made at the beginning of the experiment and at the end of eight months. The rice was stored at approximately 16, 14, 11, and 8 percent of moisture at atmospheric conditions and under about a 28-inch vacuum. It appears, therefore, that there is no very marked difference in the viability of the fungi that occur on rice hulls under vacuum and atmospheric storage at 8 to 16 percent moisture.

Black Kernel Disease: Attempts to produce black kernels in rice by spraying flowering rice plants with a spore suspension of *Curvularia lunata*

were unsuccessful when tried on a field scale. The weather conditions during ripening and harvest were not conducive to black kernel development. Inoculation of greenhouse rice plants by injection of a spore suspension of *C. lunata* into the flowers or grains during different stages of development produced typical black grains in a few cases. The highest percentage of successful infection obtained by this method was 60 percent. In many cases no infection occurred. Attempts to culture the organism from year old infected seed were unsuccessful although seed from the same source produced abundant growth of the fungus when cultured several months after harvest.

White Tip: Manganese deficiency in rice was noted as a general yellow-green chlorosis. Frequently the leaf tip may be normal and the chlorosis may appear in the middle of the leaf. This condition is markedly different from white tip.

Previous work on white tip indicated that the disorder can be caused by low calcium-magnesium ratios. Using the chlorides as the sources of magnesium and calcium in sand culture, white tip occurred when the concentration of magnesium was greatly in excess of the calcium concentration as previously reported. Calcium and magnesium were applied to field plots in 16 different ratios. No particular ratio seemed to affect the incidence of white tip which was unusually high at the station this year.

Straighthead: The straighthead disease of rice is believed by many investigators and farmers to be caused by toxic substances such as methane gas formed in the soil. Methane was produced in the laboratory and bubbled through the cultures several times a day. Plants so treated produced seed normally and did not have any straighthead symptoms. A preliminary soil culture experiment in the greenhouse on straighthead of rice substantiates the observations made on a similar field test. When plants were grown in soil which had produced straighthead, the amount of sterility was reduced by the addition of trace elements to the soil. Copper was the most effective element in reducing the sterility.

Miscellaneous Physiological Studies: Inconsistent results were obtained when rice growing in outdoor cylinders was flooded with irrigation water containing 25 to 100 grains per gallon of sodium chloride. Although the data obtained are not conclusive they indicate that sodium chloride may not be as injurious to rice as many farmers believe.

Sulphur was applied at the rate of one ton per acre in a so-called alkali spot or knoll about three months before planting. The initial pH of the soil was 7.4. The pH of the treated soil just before planting was 4.4. The plants treated with sulphur produced a better stand, more vigorous plants with better color and yielded about twice as much grain as plants growing in untreated soil.

Four nutrient solutions used by other investigators for certain dryland crop plants were tested on rice in greenhouse cultures. The solu-

tion producing the greatest yield of grain had the following composition in millimoles per liter: Primary potassium phosphate, 1.2; calcium nitrate, 2.4; magnesium sulphate, 1.2; ammonium sulphate, .7. This solution is one used by Shive and Robbins but the concentration of the salts has been reduced to one-half of the recommended amounts. Plants grown with this solution were superior to field grown plants.

Minarik.

Field Crop Investigations

Cotton: Frequent and heavy rains during the growing season resulted in very low yields of cotton. These yields varied from 198 to 102 pounds of lint per acre. Ambassador produced the highest yield and Qualla the lowest.

Corn Variety and Hybrid Yield Test: This test suffered from the excessive rainfall too. One of the hybrids, (155a x 102) x 4R-3, produced the largest yield of 16.4 bushels per acre, and Ferguson Yellow Dent produced the smallest of 5.4 bushels. Thirty-one varieties were included in the work, but, as mentioned, the results were very unsatisfactory on account of unfavorable climatic conditions.

Castor Beans: This test of eight varieties was practically a complete failure as this crop apparently cannot stand heavy rains when grown on poorly drained soil. The yields of seed varied from only 20 to 62 pounds per acre, and all plants were much smaller than usual this season. The results this season showed the need of planting this crop on well drained soil.

Wyche.

Forage and Pasture Crop Investigations

Pasture Fertilization: This work includes applications of nitrogen, phosphoric acid, separately and in combination on both limed and unlimed soil. Lime continues to show beneficial results. Nitrogen alone appears of little value. Phosphoric acid produces good increases in yield. However, the largest increase of dry forage, 201 percent, was obtained from a combination of nitrogen, phosphoric acid, and potash on limed soil. The including of potash increased the yield very little.

Soybean varieties Germination was exceptionally good in all cases, but, as with the other crops, flooding by heavy rains severely injured all varieties. Some of the late varieties made fair growth, but in no case was the yield of seed satisfactory. In that the weather conditions were very unfavorable, this test should be continued.

Annual Sweet Clover Nursery: This test was planted in the fall of 1940. Good stands were obtained on all plats. Fair growth was obtained on practically all plats but none of the selections or varieties appeared superior to the commercial *Melilotus indica.*

Winter Legume Nursery: The planting in the fall of 1941 included 41 varieties. Fair stands were secured but very little growth has been

nade at this time. However, the growth is comparable to that made y clovers in other plantings in this locality. Wyche.

Iorticultural Crops Investigations

Citrus: Several of the Meyer lemon trees produced a few fruit and he Satsuma oranges produced a fairly satisfactory crop. None of the rees have fully recovered from the injury from low temperatures dur- ng January 1940. This continues to be a rather doubtful crop for his locality on account of the danger of injury from cold weather.

Pears: Two trees of hybrid pear, T.S. No. 7493, were planted on his substation in 1924. These trees had been setting a nice crop of ruit each year from 1935 to 1940. These trees bloomed but very little his season and set only some six or eight fruit per tree.

Tung Oil: The yield of nuts was somewhat larger this season, but he trees on the station did not produce yields that were as large as vas obtained on some of the commercial plantings located on sandy, well- rained soil in the counties north of Beaumont. The growth of these trees ontinue to indicate that this crop should be planted on better drained and. Wyche.

'oultry Feeding Work

The value of Rough Rice as a Feed for Laying Hens: The purpose f this test is to determine the effects of rough rice as compared with rain sorghum upon the seasonal egg production, broodiness, body veight, seasonal molt, and mortality of laying hens. Two pens of Leg- iorn hens received the same conditions and rations except that in the ne case rough rice was used for scratch grain and for the grain por- ion of the mash while in the other case grain sorghum was used for cratch grain and for the grain portion of the mash. The pen receiv- ng the rice consumed 20 percent more grain and mash and laid about 3 percent more eggs than the pen receiving the grain sorghum. The veight of the birds at the close of the test were the same. This indicates hat if or when rough rice is available at a price comparable with grain orghum, it should be a profitable feed. Wyche and Sherwood.

SUBSTATION NO. 5, TEMPLE

(In Cooperation with the Soil Conservation Service, U.S.D.A.)

Substation No. 5 is located approximately two miles south of Temple, n what is known as the Blackland region of the State, comprising an rea of approximately 11,000,000 acres. This station is known locally s the Blackland Experiment Station. The soils are gently rolling and re predominately of the Houston and Austin clay series. The average nnual rainfall for the past 29 years is 35.1 inches. The rainfall for 941 was unusually excessive, 44.29 inches.

The station serves in the solution of the major crop and soil problems of the region. The soil conservation work of the station is in cooperation with the Soil Conservation Service, Research Division, and consists of practices in both soil and water conservation, land use investigations, and the study of certain physical and chemical properties of the soil. Research pertaining to crop and crop production, crop improvement, livestock investigations, cotton root-rot problems, crop and plant diseases, and insect control are being studied by the Texas Agricultural Experiment Station.

Crops and Crop Products

Cotton Experiments: Excessive moisture conditions, boll weevil, cotton root rot, and Angular leaf spot working together gave the lowest cotton yields at this station in the past ten years. Of the 36 varieties grown in 1941, the five highest yielding varieties, in order of production, were: Deltapine 14 (44-51), with 270 pounds of lint cotton per acre; Hi-Bred, 269 pounds; Lockett 140, 260 pounds; Mebane (Buckellew), 254 pounds; and Mebane, Bryant (4A-39), 245 pounds. Both staple lengths and grades were much lower this year due to heavy rains at picking time and general disease conditions of the crop. Reduced yields in cotton were experienced in all low-lying areas which were poorly drained. The areas of cotton less affected this year were those on higher, better drained soils. Cotton in rotation with corn and oats (with cowpeas plowed under for green manure) produced 249 pounds of lint cotton per acre as compared to continuous cotton check with only 131 pounds. Cotton in a rotation with corn and oats (sorghum plowed under for green manure) produced 203 pounds of lint per acre as compared to continuous cotton check of 66 pounds.

In the soil building studies, Hubam clover and selected strains of cowpeas offer the best posibilities for soil building purposes. This year cotton after cotton yielded 540 pounds seed cotton per acre. However, cotton after Hubam, which was harvested for seed, the yield of seed cotton was 1110 pounds per acre, an increase of slightly more than 100 percent. On this same area, root rot was reduced from 71 to 15 percent. Cotton after Hubam, harvested for hay (with second growth turned under for green manure) made a yield of 1015 pounds seed cotton per acre.

Corn Experiments: This station is leading in the production of foundation seed for hybrid seed corn production of the State. This year Texas hybrids yielded 26 percent more than the best open-pollinated varieties. The corn crop for this area was greatly reduced this year on account of excessive rainfall. There was severe weevil damage in both field and stored corn, the worst in ten years. Corn drowned out badly in low-lying areas and produced only a fair crop on the better drained soils.

Corn after corn yielded 43.4 bushels per acre as compared to corn after Hubam (harvested for seed) with 48.4 bushels per acre. Corn after

cotton this year, however, made an excellent yield of 49.0 bushels per acre.

Grain Sorghum Experiments: Grain sorghums for grain production were complete failures due to weather conditions which were favorable to the sorghum midge infestation followed by infestation of sorghum web worms. From the standpoint of forage production the season was very favorable. Gooseneck sorgo gave the highest production in forage with a yield of 5.78 tons per acre, followed closely by Honey with 5.76 tons. Other high forage yields were: Manko, 4.32 tons; Atlas sorgo, 4. 21 tons; Leoti, 4.07 tons; Darso, 3.89 tons; and Sumac, 3.80 tons.

Small Grain Experiments: Excessive rains during the early spring caused very rank growth in all small grains and leaf and stem rust infestations appeared early and were most severe. Heavy rains at the time the grain was ripe and following harvest caused much damage from grains sprouting in the shock. Wheat yields were exceedingly low. Oat yields ranged from slightly more than 40 bushels to as low as 26.6 bushels per acre. The results this year show the superiority of New Nortex, Rustler, and Ranger as to yield and rust resistant quality. New Nortex appears to be the best variety of oats for this area. This year barley gave the best relative yields of any of the small grains in the rust resistance test with yields ranging from 25.2 bushels per acre for Harlan Hybrid, 1-32-102 to 14.5 bushels for the variety University of Tennessee No. 5, Texan, the new smooth awned barley, was second in production with a yield of 22.8 bushels this year.

The season was rather favorable for flax production. Of the 19 varieties planted this year, the yields ranged from 11.8 bushels to as low as 3.2 bushels per acre. Five of the varieties yielded better than 10 bushels per acre.

Winter Legume Experiments: This year this test included 21 strains or varieties of sweet clover, 9 varieties of alfalfa, and 3 varieties of vetch. Very little growth was made on these legumes until the weather began to warm up in the spring. In the sweet clover group, Montana Hubam made the highest yield with 2.93 tons per acre of air-dry forage and 597 pounds of seed per acre. This was followed by Temple Melana Hybrid with 1.96 tons of forage and 336 pounds of seed; Ames Hubam with 1.90 tons forage and 269 pounds seed; and Temple Hubam with 1.77 tons forage and 675 pounds of seed.

In the alfalfa group, Hairy Peruvian made the highest yield of 1.7 tons of air-dry forage per acre, followed by Kansas Common, Selection A-11, and Pilca Buta with 1.32 tons each.

In the vetch group, the yields in order named, were Common vetch, 2.18; Hairy, 2.04; and Hungarian, 1.70 tons air-dry forage per acre.

Castor Bean Experiments: Eight varieties of castor beans have been under test at this station for the past three years. In 1941 the yields of

castor beans ranged from 579 pounds threshed seed per acre for the Flowering variety to 189 pounds for the Common. The three-year average yield ranged from 1045 pounds per acre for Flowering to as low as 114 pounds for Common. Castor beans in this area are very susceptible to cotton root rot disease.

Cotton Root Rot Problems

(In Cooperation with the Bureau of Plant Industry, U. S. D. A.)

Sclerotial Studies

Field Samples: The results of sampling 180 plots by 6-inch intervals to a depth of 42 inches show that the greatest number of sclerotia were found between the depths of 24 and 30 inches. Large quantities, however, were found at the greatest depth of 36 to 42 inches, while a few were found at the extreme depth of 8 feet. The percent of viable sclerotia found at this great depth is exceedingly small.

General Root Rot Studies

Rotations: Except in a few cases, the effect of rotation treatments could not be well measured in 1941 due to delayed and extremely late planted cotton caused by continued wet weather. It is well known in the area that late planted cotton does not die as readily from root rot disease as early planted cotton. It is also the general experience that late planted cotton in the Blackland region produces very low yields of lint cotton.

In the rotation of cotton, corn, oats, where cowpeas were planted on oats stubble and plowed under in September of 1940, there was a reduction in 1941 in cotton root rot. The root rot on this area was 41.3 percent as compared to 77.6 percent in the continuous cotton check. In a similar rotation where sorghum was planted on oats stubble and turned under for green manure, the root rot in 1941 was 63.3 percent on this area as compared to 83.0 percent in the continuous cotton check.

Barnyard manure turned under in the fall at the rate of ten tons per acre gave significant reduction in cotton root rot. Four different commercial fertilizer treatments to cotton in a 4-year rotation gave no decrease in root rot infection.

In a two-year rotation, cotton following Hubam clover (the clover harvested for seed crop with residue plowed under) showed an end-season root rot infection of only 15 percent as compared to 71 percent infection in the continuous cotton check.

Midseason (August 16) root rot count on plats was 25.6 percent where the cotton stalks were plowed under green early as against 44.4 percent infection for the plats where the cotton stalks were cut early, but were not plowed under. The dates at which cotton plants are killed by root

rot greatly affect cotton yields. Cotton plants killed as early as July 15 to August 1 averaged in yield from 3 to 22 pounds of seed cotton per acre; August 15, 135 pounds; September 1, 498 pounds; September 15, 674 pounds; and from cotton remaining green on October 1, the yield was 1252 pounds per acre. All of the cotton of this test was picked on October 1.

Improved selections of cowpeas from the Iron and Brabham varieties have shown high resistance to both root rot and chlorosis on the Blacklands of Central Texas.

Summer grown varieties of all clover and alfalfa are susceptible to root rot but when planted in the early fall and harvested in June and early July, the following year show very little if any losses from cotton root rot disease.

Cotton planted in 1941 on plats that were treated with crude oil in November 1937 at 2000 to 15000 gallons per acre varied in root rot infestation from 2 percent on plats treated with 8000 gallons to 14 percent for the no treatment check. This shows that after four years crude oil still has good residual effect on reducing cotton root rot. The practice is not recommended but deserves further trial. Good yields were obtained and root rot was reduced by injecting crude oil 18 inches into the soil from equipment attached to a killefer subsoil plow.

Plant Disease Studies: Cotton seedlings from acid delinted seed had no disease infection while those from untreated fuzzy seed had disease infection of 89.3 percent. Seedlings from various mercury compounds had a fairly low infection, ranging from .5 to 3 percent but gave an increase in germination for practically all trials. In the treatment of sorghum seed for the control of smut, 16 materials were used, and the best results were obtained where one ounce of copper carbonate per bushel was used. Oat smut was controlled successfully by using a formaldehyde spray (1 pint formalin to 1 pint water) and also using 5 percent Ceresan, ½ ounce per bushel.

For the control of Angular leaf spot of cotton, wettable sulphur at 2 ounces per gallon as a spray was superior to all other mercury and copper compounds used.

Rose chlorosis was controlled successfully with an iron spray consisting of 1 percent Auqueous Ferrous Sulphate Solution with Grasselli Spreader-Sticker when applied as a fine spray.

Other plant diseases of importance in 1941 were felty limb canker on hackberry; mildew on roses, crape myrtle, lilacs, zinnias, coralberry, and cowpeas; black spot and chlorosis disease of roses, chlorosis on many ornameital and fruit trees such as ligustrum, spirea, abelia, peach, and plum; Angular leaf spot on plum and peach trees; and rust on alfalfa and cowpeas.

Livestock Investigations

The economic utilization of livestock in the Blackland region of the State has been made an integral part of the practical land use and well-rounded agricultural program for this station. The 34 acres along Boggy Creek on the station farm, formerly idle land, is now being used as a permanent pasture for sheep and cattle, and through this class of livestock, is producing more net income per acre than any other station land. Surplus feeds are being marketed through livestock channels, thus leaving the manure on the land for fertility.

Sheep: Sheep are useful farm animals in harvesting weeds and in keeping pasture areas, drainage ditches, and waste land free from weed infestation. In addition breeding experiments are under way to develop a farm type of mutton sheep suitable for the Blackland region of the State. The foundation for this new type is polled Rambouillet ewes bred to Dorset rams. This breeding work is done in cooperation with the Division of Range Animal Husbandry of the Experiment Station.

Cattle: In 1941 no cattle were fed out at the station. The station herd now consists of 10 grade Hereford heifers, 10 Registered Hereford heifers, and one Registered Hereford bull. The herd is being utilized for grazing in the permanent creek pasture in conjunction with sheep.

Hogs: Surplus corn and other grain feeds are marketed through the fattening of hogs. In 1941, 127 fat hogs were marketed in this manner.

Poultry: In cooperation with the Poultry Division of the Experiment Station, a test was conducted to study the value of oats as a substitute for corn in the mash for laying hens. The average egg production was almost identical, being 150.7 for the group receiving the mash containing oats as compared to 150.3 eggs for the group receiving corn in the mash. There was practically no difference in the two groups in the pounds of feed consumed per dozen eggs produced and no difference in mortality. The test indicates that oats make a very satisfactory and useful feed in the mash for laying hens. Hill.

Soil and Water Conservation Investigations.

(In cooperation with the Soil Conservation Service, U. S. D. A.)

Soil and water conservation investigations at the Blackland Experiment Station have been in progress since 1929. This work is applicable to the Blackland region of Texas and to parts of the Grand Prairie.

The underlying principle of the soil conservation research work is to "derive from the land the maximum benefit consistent with the permanent maintenance of that resource." The soil conservation work itself is directed toward the permanent maintenance of soil resources, while the associated land use investigation and farming practices are providing practical ways to increase farm income.

Strip Cropping Investigations: Three years' results (1939-1941) have now been obtained from the strip cropped 1½-acre plots established in 1939. The treatments on the plots are cotton, oats, corn in a 3-year rotation alone, and cotton, oats, corn rotated and strip cropped. The crop strips are 36 feet wide and contour guide lines are 108 feet apart. All cultivation is on the contour. The soil is Houston black clay and Austin clay. On a 2 percent slope the 3-year rotation of cotton, oats, corn had an average annual soil loss of 1.05 tons per acre as compared to .55 ton where the crops were rotated and strip cropped. The run-off from the rotation alone was 4.85 percent as compared to 4.51 percent of the rainfall lost as run-off from the rotation strip cropped. On a 3 percent slope, the average annual soil loss for the 3-year rotation of cotton, oats, corn was 5.3 tons per acre as compared to 1.57 tons per acre for the same rotation strip cropped. The water loss for the rotation alone was 10.09 percent as compared to 7.27 percent of the rainfall lost as run-off from rotation strip cropped. The concentration of water an a 3 percent slope was sufficient to cause severe gullying in both the rotation alone and the rotated strip cropped plots.

On the 1½-acre strip cropped plots and on strip cropped fields with slopes from 2 to 4 percent and with different widths of crop strips, observations are made after each rain to record the extent of erosion in the various strip cropping systems. These studies indicate that:

1. Once the contoured rows break and a gully starts, 36-foot erosion-resistant strips of oats do not successfully disperse the accumulated water and gullying continues immediately below the oat strips.

2. On land slopes greater than 2 percent accumulated water on strip cropped land is sufficient to cause recurrent gullying in the same depression. This indicates a need for terrace to divert the water to protected outlets.

Terraces with and without Strip Cropping: Two years' records (1940-1941) have been obtained from terraces with strip cropping as compared to terraces without strip cropping.

The average annual soil loss from the strip cropped terraces was 1.18 tons per acre as compared to 2.49 tons per acre for the row cropped terraces. The water loss from the strip cropped terraces was 16.37 percent as compared to 20.84 percent of the rainfall lost as run-off from the row cropped terrarces.

Protection of Eroded Land by Re-Vegetation with Grasses: The utility of grasses used in re-vegetation should always be considered. This area needs a good winter grazing grass in addition to Rescue grass which is found widely distributed. In cooperation with the Division of Agronomy and the Bureau of Plant Industry, strains of winter-growing perennial grasses are being tried out. In 1941, the following were established for observation as to cold resistance, adaptibility, and vegetative characteristics:

30 strains of Rhodes grass *(Chloris gayana)*
5 strains of early medow fescue *(Festuca elatior)*
3 strains of Italian rye grass *(Lolium multiflorum)*
3 strains of perennial rye grass *(Lolium perenne)*
3 strains of orchard grass *(Dactylis glomerata)*

Hubam Exploratory Study: Blackland soils generally do not respond sufficiently to the application of commercial fertilizer to pay the cost of fertilization, but good response is obtained from legumes and green manure crops. Legumes do not grow well in the winter. Late manuring and perennial legumes are severely damaged by cotton root rot in the summer. Hubam clover and selected strains of cowpeas offer the best possibilities for soil building purposes.

Straw Mulch Investigations: An exploratory study has been started to determine the effect of straw mulch and other farming practices on moisture conservation, certain physical and chemical properties of the soil, and crop yield. The various treatments are laid out in triplicate plots approximately 7/100 acre in size. Soil moisture samples are being taken, and soil structure and temperature changes will be measured during the progress of the work. The effect of the mulch on nitrates will also be determined. Some difficulty has been experienced in attempting to sub-cultivate in the Blackland soils. Changes in the type of machinery will be necessary for satisfactory performance of mulch farming.

Laboratory Investigation of Soil Properties Affecting the Erodibility of Soil: To determine the effect of various physical properties of the soil and infiltration and erosion and the effects of certain cultural practices on these physical properties, studies were started on eroded and uneroded soils and on soils known to differ in erodibility and infiltration capacity to determine which factors and properties are important in these relationships. Peevy.

SUBSTATION NO. 6, DENTON

This station is located 5.5 miles northwest of Denton in Denton County. The soil is representative of the Grand Prairie Region of North Texas. This region is especially suitable for small grain production although corn, cotton, and grain sorghums are important crops. The average annual rainfall for the period of 1913 to 1941, inclusive, is 32.84 inches, of which about 25 inches is estimated as effective for growing crops.

A large part of the work of this station is devoted to the breeding and improvement of wheat, oats, and barley, although considerable time and effort are being devoted to the breeding improvement of other field crops adapted to North Texas conditions.

Small Grain Investigations

(In Cooperation with the Bureau of Plant Industry, U. S. D. A.)

Growing Conditions: Weather conditions for the small grain crop season of 1940-41 were among the most unfavorable on record. For the

third consecutive season, the fall season was very dry so that grain did did not emerge until November. Starting with rains in December, excessive moisture was present throughout most of the remainder of the season. This caused very low growth, with an abnormally small amount of stooling, and production of short stunted plants. Injury by stem rust, and Septoria resulted in low yields and very low test weights.

Wheat: Twenty-one varieties and strains of hard and soft winter wheat were tested in replicated field plats. Yields ranged from a low of 2.8 bushels per acre for Clarkan with test weight of 43.0 pounds per bushel, to 11.0 bushels per acre for Comanche, with a test of 52.0 pounds. Over a period of years, leading hard wheat varieties are Comanche, Kawvale x Tenmarq, C.I.11669, Quivira, and Tenmarq.

In replicated nursery tests, 97 varieties and strains were tested in comparison with commercially grown varieties. Early maturing strains escaped diseases to some extent and were the most productive. The leading strain in this nursery was Early Blackhull x Tenmarq, C.I.11951, with a yield of 19.6 bushels per acre.

Breeding work to develop stem and leaf rust resistant soft wheat varieties for this area continued with the growing of more than 4,000 plant rows from the new hybrids. Some 200 selected strains from this test include the most promising material ever developed at this station.

Cooperative varietal tests of wheat were continued with the U. S. Cotton Field Station, Greenville, Texas. Yields at that location were high and quality good. The highest yields were produced by Tenmarq and Comanche.

Oats: Leading varieties in the fall-sown test were Ferguson 922, 24.0 bushels per acre, and Texas Red Rustproof, 1415-12, 22.8 bushels. Over a period of years the leading varieties are Texas Red Rustproof, 1415-12, and New Nortex. These same varieties have also produced the highest yields from spring seeding. Fultex oats, the new strain especially suitable for combining, was less productive from both fall and spring seeding than the better Red Rustproof strains this year.

The fall-sown nursery test produced high yields of good quality grain. Leading strains in yield were the Red Rustproof strains and Fulghum x Victoria strains. From spring seeding, the test produced very low yields of low quality grain. The test was injured by greenbugs, blade blight, and excessive moisture. Under these conditions the highest yields were produced by the Fulghum x Victoria selections including Fultex and Victorgrain.

Barley: Located on a poorly drained area, the variety test was almost a failure. Yields ranged from 8.9 to 15.5 bushels per acre, the highest yields being produced by Texan and Finley. Texan barley, a new smooth awn variety formerly called Harlan Hybrid, 1-33-7, is now being distributed to farmers in Central Texas by the Temple substation.

Flax: Seven varieties of flax were grown from three dates of seeding this year but all produced low yields. Repeated tests have shown that March 10 to 20 is the best date of seeding. The average yield of flax planted between March 10 and 17 is now 12.5 bushels per acre.

Atkins.

Field Crops

Corn: In the variety test, the best Texas hybrids yielded approximately 20 percent more than the best native varieties and 10 percent more than the best out-of-state hybrids. The highest yielding native varieties in 1941 were Doyle's Red King, Skiles' Yellow Dent, George's Yellow Dent, and Denco Yellow Dent. For the 10-year period, 1932-41, Denco Yellow Dent, White Surcropper, and Ferguson Yellow Dent are the leading varieties. The highest yielding Texas hybrids in 1941 were No. 7-W, No. 12, and No. 8. The highest yielding out-of-state hybrids in 1941 were Pioneer 300, Iowealth Tx No. 3 and Iowealth Tx No. 1. The latter two contain Texas inbred strains.

Commercial Production—Texas Hybrid No. 8, Yellow Surcropper x (127C x 132A), was produced on 25 acres, and Texas Hybrid No. 14, (132A x 173D) x (Kys x 38-11), was produced on 25 acres. Approximately 400 bushels graded seed of each hybrid was sold to farmers this year.

This station produced State Registered seed of Yellow Surcropper and Denco Yellow Dent primarily for sale to Sate Certified seed growers.

Sweet Corn Hybrid Test: A test of 16 sweet corn hybrids was grown for the purpose of determining differences in tenderness, flavor, worm damage, and production of marketable ears. The yield of marketable ears. The yield of marketable ears ranged from 1276 pounds to 2871 pounds per acre. The high yielding hybrid 3610-12R-1 x 135 graded excellent in tenderness and flavor. Dunkle.

Grain Sorghum: Variety Test—Fifteen varieties of grain sorghums were included in the test this year. Texas Double Dwarf milo, Ajax, and Early Hegari made the highest yields of 44.2, 39.5, and 38.5 bushels grain per acre, respectively. Dwarf Quadroon, T. S. No. 7072-51-4, Darso No. 28, and Quadroon made the highest yields of dry forage, 6.36, 5.89, and 5.16 tons per acre, respectively.

Effect of Grain Sorghum and Corn Upon Succeeding Crops

Since 1933 a study has been made of the influence of the sorghum varieties and corn on the yield of oats, wheat, barley, corn, cotton, and cowpeas. The entire stalk of corn and the stubble of the sorghum varieties are plowed under about September 1 or soon thereafter. Yields of fall planted wheat and barley and spring planted oats are reduced 10 to 15 percent, whereas corn is affected very little, and cotton and cowpeas are not lowered at all. Apparently the depressing effect of the sorghums upon following crops is only temporary and such crops as are planted

as late as April of the following year are not depressed. This experiment is important to farmers in that the tests clearly show that they need only to plow under their sorghum residue as early in the fall as possible and then follow with a late spring crop, as cotton, sorghum, cowpeas, etc.

Dunkle.

Cotton: Variety Test—The average yields from six replications of each of the 36 varieties in the test this year were less than in 1940, but considerably above the 10-year average. Watson, Deltapine 14, Buckellew Mebane, Western Mebane 140, Mebane (A.D.M.C.S. Co.), Hi-Bred, Bryant Mebane 4A-39, Mebane (A.D.Est.), Union, and Harper made the highest yields in the order named.

Breeding: Large populations of F_2 plants from cotton crosses, Sun shine x Rogers Acala and Sunshine x D.P.L. 11A, were grown this year. From three to five inbred bolls obtained from each plant were rated for staple characteristics and only seed of the best plants was saved for growing the F_3 in 1942. The ultimate goal is the development of a superior new variety of cotton.

Wide Row Spacing: Cotton was planted in 6-foot rows, in two 3-foot rows and skip, and in regular 3-foot rows, with same number of plants per acre in all three spacings. The yields of seed cotton this year were 586, 986, and 1041 pounds per acre, and for the three-year period, 1938-41, the yields were 673, 720, and 777 pounds per acre, respectively.

Dunkle.

Legumes

Variety Test: A large number of vetches, annual and biennial sweet clovers, true clovers, winter peas, and miscellaneous legumes, planted in late October 1940, had just emerged at the time of a hard freeze on November 15. About one-half of the plantings were completely killed and the remaining half varied in survival from 40 to 90 percent. The common bur clovers, the biennial sweet clovers, most of the vetches and winter peas made satisfactory recovery and were harvested for forage yields. The outstanding legumes from fall plantings were Madrid Yellow, Madrid White, Iowa Late White, Montana Yellow Blossom, and Ohio Evergreen biennial sweet clover. The outstanding 1941 spring planted legumes were Hubam and Melana annual sweet clover.

For fall planting and use for pasture and soil improvement, the bur clovers, Black Medic, and alfalfa have given satisfactory results. Hairy vetch and Austrian Winter peas will withstand average winter freezes and are fairly satisfactory for hay or soil improvement; however, these legumes make very slow growth during the winter, furnish very little pasture and ordinarily do not produce seed sufficient to harvest or to insure a good volunteer stand.

For spring planting, sweet clovers, particularly Madrid, a yellow blooming biennial, have proved superior to other legume varieties for hay,

pasture and soil improvement. Hubam cannot be fall planted in this area and, when spring planted, does not yield as well as the biennial varieties. It matures earlier than the biennials and should be given preference on land infected with cotton root rot disease. Cowpeas are very satisfactory for soil improvement on land not infected with cotton root rot. The Brabham variety is fairly resistant to root rot. The Chinese Red variety is the most satisfactory for both seed and forage production.

Sweet Clover Varieties: A separate test of 12 varieties of biennial sweet clover showed Madrid Yellow to be outstanding in both first and second year growth. This station is increasing this variety and should have seed to sell in 1943.

Sweet Clover Method of Planting: Sweet clover planted in 36-inch rows alone or with spring oats as a nurse crop has been more satisfactory, particularly dry years, than when planted broadcast or with a grain drill. Planting alone in 36-inch rows is recommended for thin, drouthy natured soils and when grazing and soil improvement are mostly desired. When sweet clover is planted in spring oats by any method, the yield of oats is slightly reduced, and the sweet clover does not make sufficient growth following harvest of the oats to be cut for hay, but is valuable for late fall pasture or for turning under as green manure.

Legumes Interplanted with Oats for Hay: Oats planted alone yields considerably more than when mixed with Austrian Winter peas, Hairy vetch, or sweet clover. Hairy vetch and oats is the best combination for both yield and quality of hay. Austrian Winter peas and sweet clover make very poor growth when mixed with oats and add little or nothing to the quality and yield of the hay.

Soybeans: Approximately 300 varieties of soybeans were grown in a preliminary test for the purpose of determining forage and seed yields and general adaptation to the area. Because of excessive wet weather in May and early June, the forage yields were somewhat below normal, ranging from a low of .23 to 1.37 tons forage per acre. Many of the varieties yielded from .80 to 1.00 ton per acre, but, in general, these high forage producing varieties were low in seed yields. Varieties fairly satisfactory for both forage and seed were Mamredo 607, Macoupin, Arksoy 2913, Ogden No. 97339, No. 85522, No. 71506, No. 71519, and No. 71443.

Seed Production: Only 76 of the 300 varieties made seed. Their yield ranged from .24 to 16.3 bushels per acre. The highest yielding varieties were No. 71519, Ogden 302, No. 97339, No. 71443, No. 71506, Arksoy, Mamredo, and Macoupin. Thus far in our soybean tests, dating back to 1923, no variety has given satisfactory or consistent yields of seed. Therefore, soybeans cannot be recommended for planting in this area except for forage and soil building purposes. Dunkle.

Crop Rotation Studies

Cotton: Rotation of cotton with corn and small grains is a common practice in this North Texas area, and the experiments thus far do not suggest a more profitable practice.

Corn: Rotations in which sweet clover or cowpeas are planted as annual soil building crops have increased the yield of corn slightly. Other types of rotation have had little or no influence on the yield of corn.

Wheat: Rotating wheat with other small grains or corn has materially increased yields when compared with wheat grown continuously on the same land. The use of sweet clover in the rotation has produced profitable increases in the yield of wheat.

Oats: The yield of oats has been significantly increased by rotation with corn or cotton and by the use of sweet clover for soil improvement. Planting sweet clover in oats has reduced the yield of oats slightly but this loss is converted into gain when the oats follow sweet clover plowed under two or three months ahead of planting. Dunkle.

Pasture Experiments

Buffalo Grass: Twenty-three of the 24 strains of Buffalo grass, seeded in 1940, made exceptionally good growth and each plat a dense turf cover by May 1941. Strains No. 14, 1202, 154, 848, 832, and 779 set their seed from 6 to 9 inches above the ground. Seed of all strains was harvested as a single plat with a combine set to cut as low as possible. A yield of 181.5 pounds per acre of clean seed was secured.

Buffalo Grass Seeding and Sodding: When seed of Buffalo grass is available, seeding on firm lister bed 6 feet apart is practical and cheaper than sodding. Seedings should be made in late spring at the rate of 20 pounds per acre and carefully cultivated during the summer to keep out all grasses and weeds. Pre-soaking the seed from 2 to 5 days before planting increases and hastens germination. Seeding with a drill or broadcasting by hand give very poor results because of inability to keep down weed growth.

Sodding Buffalo grass stolons or sod pieces in listed furrows, 3 feet apart and 6 feet apart, has proven to be a slow method of establishing the grass under field conditions because of the difficulty of keeping down weed competition. This method is very satisfactory in establishing a lawn where water may be applied immediately after sodding and close clipping with a lawn mower controls weed growth.

Tall Grass Varieties: Tall grasses that occur naturally in native grass pastures in this area, particularly in seasonable years and where lightly grazed, consist largely of Little Blue Stem, Big Blue Stem, Side-Oats grama, Texas grama, and Switch grass. These grasses will not withstand continuous or severe grazing and are valuable only as meadow grasses. Dunkle.

Castor Beans

Eight varieties of castor beans were planted at two dates, May 19 and July 3. The yields ranged from 6.6 to 15.5 bushels clean seed per acre, and the shelling percent ranged from 70 to 76. Van Over, Conner, and

Flowering made the highest yields. Since weather conditions in 1941 were almost ideal for growth and production, the yields reported probably are the best that could be expected. In previous tests no variety had exceeded 10 bushels. Dunkle.

Poultry Feeding Test

In cooperation with the Poultry Division, a test was conducted to determine the value of a laying mash for White Leghorn pullets under average farm conditions. One hundred pullets were divided into two equal lots of 50 pullets each and given identical feeds consisting of mixed grain sorghum seeds, yellow corn, wheat, oats, and barley; an equal amount of kitchen scraps, about two gallons skim milk to each lot and about one-half acre grazing area in which winter wheat, Italian rye grass, and Sudan were planted for pasture. The only variable was laying mash kept continuously before the hens in one lot while the other lot received no mash. The lot receiving no mash laid 170 eggs per bird, and consumed 4.4 pounds grain per dozen eggs laid. The lot receiving mash laid 198 eggs per bird and consumed 3.11 pounds of grain and 1.53 pounds of mash or a total of 4.64 pounds of feed per dozen eggs laid. This experiment is being continued. Dunkle and Sherwood.

SUBSTATION NO. 7, SPUR

Substation No. 7 is one mile west of Spur, Dickens County, in the rolling plains region below the Cap Rock. The average annual rainfall for a thirty-one-year period is 21.25 inches. The soil consists principally of Abilene and Miles clay loams and closely associated types characteristic of the rolling plains.

The three principal lines of research are (1) crops and crop production, (2) conservation of the soil and water resources of the region for production of cultivated crops and permanent pasture crops, and (3) utilization of feed crops and native pastures by livestock. The season of 1941 was one of heavy rainfall, a total of 42.87 inches.

Crops and Crop production

Cotton Experiments

The highest yielding variety of cotton in 1941 was burnett with 575 pounds of lint to the acre, closely followed by Watson with 568 pounds Stoneville 2B with 564 pounds, and Deltapine 14 (44-51) with 546 pounds of lint per acre. May 10 to 20 plantings of cotton produced higher yields than other dates in line with past work which indicates that the middle of May is the optimum time for planting cotton in this area. Cotton planted in 39-inch rows and spaced 21 to 27 inches apart produced the highest yields this year. This spacing is thinner than the average for a long time period, which shows that the best production is obtained from spacing the plants 9 to 15 inches in the row. Cotton that had three cul-

tivations produced more cotton than plats receiving as many as seven cultivations this year. A 19 year average shows that two cultivations for cotton here have produced the highest yield. Explanation of this is probably the fact that weed growth on the average here is limited and the minimum number of cultivations to effectively control the weeds is all that is necessary. Unneeded cultivations probably prune many surface roots of the cotton.

Grain Sorghum Experiments

In 1941 a grain sorghum cross (Hegari x Double Dwarf Milo) x Texas Milo produced the highest yield, 62.2 bushels of grain to the acre. Another selections of Hegari and a cross (Red Kafir x Hegari) produced 54.1 and 53.6 bushels of grain per acre, respectively.

These are promising grain sorghums for grain production: dwarf yellow milo, Hegari, and Blackhul kafir, which over a period of years have been most dependable grain producers in this region. The highest grain production in 1941 was made from planting on May 15. Over a period of years the highest yields have been made from plantings made the latter part of May and early part of June, which seems to be the optimum time in this region.

The planting of milo in rows spaced 39 inches apart has given the highest yield of grain and this is in accord with previous work over a period of years.

A milo cultivation test indicates that about three cultivations are sufficient and that more cultivations than needed to destroy weed growth frequently decreases yields. This is in line with previous work.

Dickson and Turner.

Soil and Water Conservation Studies

(In cooperation with Soil Conservation Service, U. S. D. A.)

Results of experiments this year on factors affecting run-off and soil losses are in line with previous work which show that the crop on the land is an important factor and affects both the water and soil losses. Permanent pasture grass is the most effective in preventing loss and grain sorghum and cotton are next in rank in efficiency. Small grains are not so efficient here as there is little heavy rainfall in the winter season. The losses seem to be in proportion more or less to the ability of the plant to utilize water and thus prepare the soil for a better water intake. The slope of the land is of course another important factor as is also the preparation of the land.

The character of the rainfall is an important factor. Torrential rainfalls were frequent in 1941, and the highest losses were recorded since these studies were begun in 1926. Seventy-seven percent of a torrential rainfall which occurred on June 15 was lost on an average from eight control plats. Twelve rains occurred during the year sufficiently torrential

to produce run-off while the average for the 16-year period that produced run-off was 9.69.

The effect of conservation of water and soil is measured largely by the interaction of these factors.

Field experimental plats ranging from 6 to 10 acres in size show that contour rows on land of moderate slope produced 450 pounds of lint to the acre as against rows with the slope producing 390 pounds. Closed level terraces produced 437 pounds lint to the acre. The differences in yield are not as great as the average difference due to more nearly approaching adequate moisture this year on all plats.

Supplementing the water supply which falls on the land by bringing water from additional watersheds and spreading it by the syrup pan terrace system has been found to be very effective in increasing production and the system is coming into general practice by farmers and ranchmen in the region Dickson and Turner.

Pasture Improvement

Pasture improvement including the control of mesquite and other undesirable range plants, mechanical, structures for conservation of water and soil, grazing practices, and maintaining a good cover of desirable vegetation is a factor of importance to utilization of range lands in this region. Experiments in the eradication of mesquite have shown that sodium arsenite solution applied to the sapwood of stumps with a paint brush after the topwood was removed killed 92.3 percent of the trees. Girdling large trees near the base and placing the poison in the groove gave complete control. Spraying stumps with kerosene killed only 62 percent of the trees or stumps. Applications of kerosene in sufficient amounts to penetrate below the crown of the shrubs gave complete control of sprouting. Twenty acres of pasture land averaging 182 trees per acre was cleared with the sodium arsenite method at a cost of $1.91 per acre for labor and poison. One gallon of sodium arsenite was used for each 200 trees.

A heavy germination of mesquite seedlings occurred in 1941 indicating that the germination of mesquite is likely to come in cycles in favorable years and that some means of eradicating young seedlings may be an important factor in keeping the land free from this plant. Ninety-five percent of the seed that pass through the digestive tract of horses and cattle have been found to be viable.

Some observations made indicate that both the yield and the quality of forage is determined by the amount of sunlight admitted to grasslands. Chemical analysis of grasses grown in partially shaded areas indicate that sugars and carbohydrates were materially reduced by heavier shading while the crude fiber and protein were slightly increased. Grasses grown under shade were taller, had finer leaves, but had less basal growth and appeared decidedly tougher than plants grown in the full

sunlight. Both buffalo grass and blue grama produced the highest yields when clipped at intervals of eight weeks.

Some studies have been made an germination of buffalo grass seed but the results are incomplete, however, it is indicated that the presence of surface litter and planting the seed at a depth of one-half inch gave better germination than deeper plantings. Grass seed were included in clay pellets for better distribution and placement of the seed with satisfactory planting and germination. The best ratio of seed to clay was 1 to 8 by weight.

Cattle Feeding Experiments

Vitamin A requirements for Fattening Beef Cattle

(Cooperative with the Divisions of Range Animal Husbandry, Chemistry, Veterinary Science, and Bureau of Animal Industry, U. S. D. A.)

In this trial, the seventh of a series relating to the carotene requirements for fattening beef cattle, five groups of Hereford feeder steer calves were fed respective carotene levels of 1250, 1500, 2500, 3000, and 5000 micrograms per 100 pounds live weight daily. Dehydrated alfalfa meal was used as the source of carotene and the respective levels were added to a basal ration deficient in carotene after the calves were partially depleted, as evidenced by the appearance of night blindness.

The differences in gain, feed consumption, feed required per 100 pounds of gain, shrinkage, carcass grade, and dressing percentage between the groups were not significant. It appears that after the minimum amount of carotene needed to maintain the animal in normal health is supplied, increased amounts do not result in increased gains or increased finish, during short periods of feeding.

Twelve of the 16 steers fed on the lower levels became completely night blind; but only 2 out of the 24 steers fed the three higher levels became night blind and 6 were apparently normal. Night blindness did not entirely disappear even on the 5000 level although this group was less seriously affected than any other group.

There was a regular increase in both carotene and spectro-vitamin A concentrations in the livers (samples secured at slaughter) from the steers on the levels ranging from 1500 to 5000 micrograms. There was also a regular increase in blood carotene from the lower to the higher levels. Biological determinations of vitamin A potency of fat and lean meat from rib samples showed higher values for the higher levels of carotene feeding; however, the vitamin A content of both fat and lean was quite low. Jones, (J. H.), Dickson, Jones, (J. M.), and Marion.

Relation of various Protein Supplements to the Utilization of Carotene

In order to determine the effect of different protein supplements on the utilization of carotene, ten heifer calves were divided into 5 groups and

fed the following protein supplements in a fattening ration: soybean meal, cottonseed meal, peanut meal, linseed meal, and a 2-1 mixture of cottonseed and cottonseed meal. The heifers were depleted of their vitamin A reserves and became night blind in 129 days, after which they were fed alfalfa leaf meal to furnish 1500 micrograms of carotene per hundred pounds of live weight daily. All of the heifers showed a progressive increase in the degree of night blindness even after they were started on the 1500 micogram level. At the end of the test, 9 of the 10 heifers were completely night blind and there was no indication that the different protein supplements had any effect on the degree of night blindness.

Cottonseed Meal and Peanut Meal as Protein Supplements in a Fattening Ration

Cottonseed meal and peanut meal, each sold under a guarantee of 43 percent protein content, were compared in a 140-day fattening trial with yearling Hereford steers of 695 pounds initial weight. The two compared lots were fed 2.5 pound per head daily of the respective protein supplements and were fed like amounts of ground milo heads and roughages. Gains were practically equal between the lots and the rate of gain was entirely satisfactory. The carcasses from both lots showed white color of external fat Jones (J. H.), Dickson, and Marion.

SUBSTATION NO. 8, LUBBOCK

Substation No. 8 is 3 miles east of Lubbock, Lubbock County, on the southern tip of the south extension of the High Plains Region. The region is known locally as the South Plains.

The average annual rainfall over a period of 31 years was 19.26 inches, with yearly extremes of 8.73 and 40.55 inches. The rainfall for 1941 was 40.55 inches. The soil is Amarillo and Richfield fine sandy loam, typical of a great portion of the region. The predominant agricultural crops of this region are sorghums and cotton. The work of the station necessarily centers around these two crops under both dry land and pump irrigation conditions. However, with thousands of acres of virgin prairie land going into cultivation each year, demands for information are varied. Soil management, crop treatments, truck, fruit, shade, and ornamental trees with emphasis on windbreaks are being studied.

Grain Sorghum Experiments

Grain Sorghum Varieties: The principal varieties of grain sorghum grown in this region are milo, kafir, and hegari, with an increasing interest in the combine types because of the economies in harvesting.

Excessive rainfall produced high humidity and cooler than average temperatures, so that sorghum production was not as great as expected. As an average for seventeen varieties under two dates of planting—

May 30 and June 18—Martin's Wheatland and Early Hegari made the greatest yields. May plantings were superior to June. This is rather interesting, as both of the above varieties are comparatively new.

Pythium Resistant Strains of Milo: Efforts to isolate superior strains of Dwarf Yellow Milo resistant to pythium arrhemomanes were continued this year. Eleven of the more promising strains grown in 1940 were compared with a non-resistant variety. Further elimination is now possible after four years of testing.

A comparison was made of resistant and non-Pythium-resistant milo on land that has been continuously cropped to this sorghum for the past 26 years. Continued cropping to milo has produced a high rate of infection to this disease, as evidenced by the yields: 18 bushels to the acre for the susceptible variety compared to 35 bushels for the resistant. On land alternated between cotton and non-susceptible varieties of sorghum, the susceptible produced 26 bushels and the resistant 35 bushels per acre.

Hegari Strains: Five strains of hegari grown at different latitudes in the sorghum region were planted at three different dates—June 3, June 18, and July 3—to study their response to length of day and planting date as measured by various characters. The greatest variation between the dates of planting was in the number of leaves and length of time to maturity. Strains from Arizona, Woodward, Oklahoma, Chillicothe, and Lubbock, Texas, showed no significant varietal difference for all three dates. Early Hegari, which is some ten days earlier than the other strains, differed in many characteristics from the others.

Combine Type Sorghums: Distributions of a number of promising kafir-milo hybrids suitable for combining were made in 1939, 1940, and 1941. From the results of these distributions and plat tests, two of these strains, S. A. 7005 and 7000, will be named. These will be increased by the State Certified Seed Growers. Yields have been equal to kafir and milo. Spacing tests indicate that eight to twelve inches between plants return the greatest yield.

Charcoal Disease, Sclerotium Bataticola: This disease results in severe lodging of the plants at approximate milk stage of the grain. It appears to be more prevalent on land continuously cropped to sorghums than on rotated land. Heaviest infections occur during years with adequate early season moisture, with a deficiency beginning about the time seed begin to set. With excellent moisture conditions throughout the entire season, practically no disease was noted this year and no opportunity afforded for selection work.

Cotton Experiments

Cotton Varieties: Thirty-six varieties of cotton were grown in 1941, the average yield of lint for all varieties was 388 pounds to the acre.

The six highest yields of lint were: Rogers Acala No. 111, 549 pounds; Mebane 804 and Northern Star, 488 pounds; Roldo Rowden, 477 pounds; and Deltapine 14 and Half and Half, 462 pounds per acre. Kasch, with 235 pounds of lint per acre, made the lowest yield. Cotton was some three weeks later than average. Cotton fleahoppers and leafworms were active, and some damage resulted. Practically all cotton is harvested by snapping instead of picking in this area. Because the market emphasizes grade over staple and the shorter lengths clean better, cotton with a staple length of 7/8 of 15/16 inch are the more popular.

Cotton Breeding: Fifty-seven crosses and backcrosses have been made and selection work has continued several years to produce an early maturing strain of cotton suitable for mechanical harvesting. This work is being done in cooperation with the Division of Agricultural Engineering, Agricultural Experiment Station.

Residual Effect from Barnyard Fertilizer and Cotton Burs: An application of 2, 4, and 8 tons of barnyard manure and 2 tons of cotton burs per acre for five consecutive years were compared with no fertilizer. To study the residual effects, none of the plats have been fertilized since 1939. This year acre yields of lint cotton of 281 pounds were secured on the no fertilizer treatment, as compared to 519 pounds on 8 tons application, and 471 pounds on 4 tons barnyard manure per acre. Two tons barnyard manure and 2 tons of cotton burs have about the same value in residual effect with yields of 368 and 390 pounds lint, respectively.

Soil Fertility and Moisture Conservation

Sixty-four 1/10 acre plats are devoted to a study to determine the effect of continuous cropping, fallow, fertilizing with barnyard manure, green manure, and various rotations on crop yields. Cotton and grain sorghum are the crops grown, with sorgo used for green manure. Barnyard manure is applied at the rate of 2 tons per acre.

Cotton: The highest yield, 427 pounds of lint per acre, was obtained from a 3-year rotation of cotton after grain sorghum after green manure; the lowest yield of 315 pounds was made from a 2-year rotation, cotton alternated with grain sorghum. Cotton continuously cropped for 27 years, with barnyard manure applied at the rate of 4,000 pounds per acre yielded 392 pounds; where unfertilized, 327 pounds.

Grain Sorghum: Grain sorghum planted continuously on land matured each year at the rate of 2 tons per acre made the highest yield this year of 39.2 bushels per acre, as compared to grain sorghum alternated with cotton with 35.9 bushels. Where grain sorghums have been grown continuously for 27 years, the yield was 31.1.

Pump Irrigation Studies

In this test all irrigations are applied at the rate of 3 acre inches of water. The postplanting irrigations are applied, as nearly as possible, at the most effective time.

Cotton: Plats receiving no irrigation water made the lowest average ield of 400 pounds lint cotton per acre as compared to the highest verage yield of 455 pounds per acre for the plat which received one -inch irrigation before planting.

Grain Sorghum: For the first time in the history of this test there as no significant difference in yields among the different irrigations, ue to the continued heavy rains throughout the entire season. Yields n the irrigated plats as a whole, were much smaller than in previous ears.

orn Varieties

Corn plays a minor roll in this area, as normally it produces about ne-third less than grain sorghums. Texas Hybrid No. 8 produced 26.0 ushels per acre, and the best open-pollinated variety yielded 28.0 ushels.

affower (Carthamus Trinctoris)

Demand for drying oils has created considerable interest in this plant. close drill planting was made March 31 under both dry-land and irri- ation. On account of the excessive rainfall, there was no difference in ields between the two methods. The irrigated test yielded 1,180 pounds f clean seed to the acre; the dry-land, 1,109 pounds. The calculated ield of oil per ton of seed was 234 pounds.

ugar Beets

Two plantings, April 15 and May 17, were made of three varieties. ive irrigations of 3 acre inches each were given. The April date of lanting was better than the May planting. The best variety (9-201) ielded 18.54 tons of beets per acre. The calculated sugar was 3,021 ounds per acre with 8.20 percent sucrose. A heavy attack of leaf spot aused about 20 percent mortality among the plants. No curly top jury was noted.

rapes

There are 33 varieties of grapes in the station vineyard. Eighty-eight nes produced grapes this year. The average yield was 5 pounds per ne. Last Rose and Ronaldo were the most productive, with average elds of 32 and 29 pounds per vine.

indbreaks

In the conifer plantings *J. Scopulorum* averaged 16 inches vertical growth mpared to 23 inches for *J. virginiana. Cupressus glabra* averaged 34 inches d *Cupressus arizonica* 28 inches. Ten varieties of pines are grown. *Pinus eda averaged* 35; *Thunbergii*, 21; *Densiflora*, 21, while *Flexilis*, with inches, made the poorest growth. Jones (D. L.)

SUBSTATION NO. 9, BALMORHEA

Substation No. 9 is located 4 miles east of Balmorhea and adjacent to the Old Spanish Trail Highway. The elevation. is about 3200 feet Average precipitation for 19 years is 14.95 inches, but annual precipitation has fluctuated from a minimum of 3.89 in 1934 to a maximum of 28.15 inches in 1932. No attempt is made to produce crops without the addition of irrigation water or flood water from some source. Humidity is low, and rate of evaporation for the area is high. Consequently, large amounts of irrigation water are required to produce normal crops. Irrigation water for the Balmorhea area comes from continuously flowing springs, supplemented by flood water from the the Davis Mountains which is caught and stored in a reservoir.

Since climatic conditions are so variable from year to year, the area is not well suited to many specialized crops, and most Station work has dealt with problems concerned with a better balanced type of agriculture. This has included the production under irrigation of many varieties of staple crops, such as cotton, alfalfa, miscellaneous legumes, sorghums, and special crops, and the utilization of these crops in the growing and fattening of cattle and sheep.

Fattening Cattle in the Madera Valley

Hereford steers of 922 pounds initial weight were used in a 156-day fattening test completed in 1941. Ground hegari and ground red top fodder were compared when fed with 2 pounds per head daily of 43% protein cottonseed meal, 4 pounds of ground alfalfa hay and approximately 5 pounds of grain (threshed milo and milo heads). The ground hegari fodder produced only 21 pounds more gain per head than ground red top fodder, however, the steers fed hegari roughage made higher dressed yield and returned carcasses of higher grade. The steers fed red top appeared to be the taller and more growthy, but lacked in smoothness and finish.

The respective roughages comprised approximately 57 percent of the total ration and therefore supplied a large part of the total energy of the ration. For this reason the higher finish of the steers fed hegari fodder appears to be significant. Jones, (J. H.), and Bayles.

Agronomic Work

Agronomic work has dealt largely with cotton, sorghums, alfalfa, and small grains.

The importance of earliness was again emphasized in the test of cotton varieties. D.P.L. 11-A has been the highest yielding variety for two years. D.P.L. 14, D.P.L. 12, and Stoneville 2-B have also been good early cottons. Acala 37-A has been one of the best strains of Acala. Three varieties of long staple cotton made a very poor showing this season due to continued heavy rains throughout the growing season. These long-staple varieties produced very little open cotton before frost.

Results of many trials with different sorghum varieties have shown hegari and red top to be among the best for this section. Alfalfa and sweet clover have been the only legumes well adapted to these conditions.

Fruit Adaptability Trials

Because of climatic and soil conditions existing in the area, it is not adapted to commercial growing of fruit crops, but most farms should have a few trees of the better varieties of peaches, plums, apricots, blight-resistant pears, and western varieties of pecans. Pecans have made a fair growth and produce regularly if located where they receive an abundance of water, but have been a failure where water was not sufficient.

Ornamental Adaptability Trials

A large amount of ornamental material has been grown on the Station over a period of many years to determine its value for this section. Some of the best varieties have been the common types of arborvitae, the Red Cedar, Pfitzers juniper, Arizona cypress, Italian cypress, Ramsey's Hybrid, and many of the deciduous varieties. The best of the broadleaf types have included the liveoak, flowering pomegranate, vitex, flowering willow, Osage orange, Arizona ash, Black walnut, and honeysuckle. Chinese elms, cottonwoods, and Russian olive have made a quick growth, but are very susceptible to the cotton root rot disease. Bayles.

SUBSTATION NO. 10, FEEDING AND BREEDING STATION

Substation No. 10 is located at College Station, Brazos county, one mile northwest of the College on the public highway; its latitude is 30 degrees north and its longitude 96 degrees west; it is 308 feet above sea level. The annual average rainfall over a period of 53 years is 38.73 inches. The land owned and assigned to the Feeding and Breeding Station comprises 920.8 acres.

The work of this station embraces investigations in the feeding, breeding, and management of swine, dairy cattle, poultry, goats, and sheep. Progress of work on projects with these animals is treated elsewhere in this report under the respective divisions concerned.

Of the land embraced in this station, approximately 150 acres are in cultivated crops, 200 acres in improved pasture, and the remaining 570.8 acres in native pasture. Sherwood.

SUBSTATION NO. 11, NACOGDOCHES

Substation No. 11 is one-half mile north of Nacogdoches, Nacogdoches County. The average annual rainfall for 29 years is 49.63 inches, with 62.82 inches for 1941. The rainfall from May to August, the principal growing period for this section was 22.50 inches in 1941 as compared to 15.75, the normal for this period. This station serves the region in which

the Nacogdoches soils, or "Redlands," occur. The redlands of the Nacogdoches soil series were among the earliest settled farm lands in the state. The virgin soil is productive, but much of it has been in cultivation for a long time and one of the chief problems of the station is to find the most effective and practical systems of cropping to build up and maintain soil fertility; other studies concern the use, rate, and time of application of fertilizers and the development of horitcultural and agronomic crops suited to a diversified agricultural program for this region.

Soil Improvement Investigations

To determine why unfavorable results obtained from continuous use of hairy vetch prior to planting cotton, as shown in the green manure studies, similar plantings were made in the concrete tank plats. All plantings of hairy vetch produced higher yields of green forage than oats or bur clover. Regardless of fertilizer treatment to hairy vetch, higher yields of lint cotton were obtained from the vetch plantings than from oats, bur clover, and where no green manure crop was used but fertilized with 400 pounds per acre of 4-8-4 formula. These results are very similar to those secured the first season under field conditions as previously shown under green manure studies.

Green Manure Studies

Due to excessive rainfall during the winter months of 1940-41 a very low yield of green manure was had from Hairy Vetch plantings. Combination plantings of oats and Hairy Vetch or oats alone were more productive than the vetch plantings.

No yields of cotton were recorded from the test due to excessive losses of plants from nematode and fusarium wilt. Some "Sore-Shin" occurred on the young seedlings. Cotton made normal growth where no cover crop was used but 400 pounds per acre of a 4-8-4 fertilizer was applied, and where neither fertilizer nor green manure crops were used.

Inasmuch as 1940-1941 crop losses occurred during this test from heavy infestation of nematode and fusarium wilt the work was discontinued at the end of the 1941 season.

Agronomic Crop Investigations

Cotton Varieties

Unfavorable climatic conditions along with heavy insect infestation throughout the cotton growing season in this section caused the lowest yields this year ever recorded. Many plantings made on the light sandy soils such as Norfolk and Ruston, regardless of the amount of fertilizer used never produced sufficient fruit to justify the expense of harvesting. Of the 36 cotton varieties and strains planted in the 1941 test, Half and Half, Hi-Bred, Greer P-34, a strain of Half and Half x Lone Star, Stone-

ville 2B, and Lankart were the five producing the highest yields of lint in order named. Lowest were made from the varieties Mebane, Acala 1517, Wilt Resistant, Delfos, Texas Special, and Lone Star, in order named.

Cotton Breeding

During the 1941 season the cotton breeding work at this station consisted of 156 progeny rows from the 1940 selections of Half and Half x Lone Star; DPL x (H & H x LS); Greer x (H & H X L S); and selfed lines of the above parents. Further selfing and selections were made from these progeny rows.

Corn Improvement

The improvement of corn for this section continues in the development of a yellow prolific variety. Approximately 100 bushels of registered seed of the Texas Golden Prolific variety were distributed from the 1940 increase plantings made for this purpose.

A strain of Texas Golden Prolific which had been crossed with Yellow Surcropper and back crossed to Texas Golden Prolific until the strain was 7/8 Texas Golden Prolific produced the highest yields. The registered seed was second highest in yield.

Additional top-crossing blocks were planted for the purpose of combining a number of selected strains of the Texas Golden Prolific and those which had been crossed with the yellow Surcropper variety.

Horticultural Crop Investigaions

Blackberry and Dewberry Variety Studies

The work on Rubus breeding during 1941 had to do with a rigid selection of approximately 250 seedlings for the purpose of selecting strains that were outstanding in production, quality, disease resistance, and other favorable characters. From this material 27 seedlings were selected and increase plantings were made from each by root-cuttings. These are being grown in the greenhouse during the 1941-42 winter season and will be planted in a yield strain test in the spring of 1942.

Adaptability Investigations with Fruit Crops

During the year further material was assembled for the adaptability study of fruit varieties in East Texas. The station orchard consists of 301 peach varieties and selections, 16 varieties and selections of plums, and six varieties of pears.

Of the 221 peach varieties producing fruit during 1941 most of the 24 varieties listed as being desirable for the East Texas home orchard in Progress Report No. 701 continued to be favorites. A number of yellow

freestone varieties were especially promising on the basis of their 1941 yield. Approximately 35 varieties of peaches were removed from the orchard at the close of the season principally because they were misnamed or of no value to this section.

The plum varieties Six Weeks, Methley, Bruce, America and Gold continue to be outsanding in yield of fruit and for home consumption.

Control Methods of Peach Insects and Diseases

Studies made toward the control of the peach insects and diseases in cooperation with the Division of Entomology and Division of Plant Pathology and Physiology and the results obtained are reported fully by these cooperating divisions.

Ornamental Adaptability Study

The purpose of this project is to have at this station specimens of both local and foreign plants in order to accumulate ecological data for the local nurserymen and landscape gardeners. A large portion of the material is used in developing the landscape design of the station farmstead. Such material included in the test this year does not have sufficient promise as to merit its being described in detail.

Slash Pine Adaptation Studies

A cooperative project on the adaptation of Slash Pine to the Nacogdoches soils is being conducted with the Texas Forest Service. Records obtained during the 1941 season showed an average lineal growth during the first six months of 38.5 inches, and a growth of 14.3 inches average for the 72 trees during the second six-month period. Diameter measurements at the end of the 12-month period showed the 11-year old trees to have an average of .6 inches increase; the average diameter of these trees is 4.8 inches. The average height of all trees at the end of the season was 26.4 feet with the tallest being 33.3 feet. Ample soil moisture was available throughout the 12-months period resulting in a favorable rate of growth.

Post Treatment Studies

Observations on the chemically treated posts made at the end of the 1941 season showed no appreciable deterioration on sweet gum, red oak, elm, and pine posts used in the test. However, untreated pine posts were rotted to the extent that replacements throughout were necessary.

Morris.

East Texas Pasture Investigations, Lufkin

This field laboratory is located six miles west of Lufkin, Angelina County, on State Highway No. 94. The majority of the land is utilized for grazing and timber production studies. The timbered pasture land com-

prised about 150 acres until this year when work was begun toward completely clearing the timber from 100 of these acres for pasture. The remaining 50 acres will be fenced sheep and goat proof and managed entirely for the welfare of the timber. A few shade trees will be allowed to remain on the acreage now in process of being cleared, and this acreage will be fenced and cross fenced to allow controlled grazing.

The average annual rainfall since the beginning of the laboratory in 1934 through 1941 is 51.04 inches with extreme of 38.51 inches in 1936 to 62.97 inches in 1940. In general, the rainfall is poorly distributed. There seems to be, little danger of a drouth so serious as to require heavy supplemental feeding or removal of a part or all of the livestock.

The detailed soil survey made by the Soil Survey Division of the Experiment Station shows that there are five different soils on the laboratory's land: namely, Lufkin very fine sandy loam; Lufkin very fine sandy loam, step phase; Caddo fine sandy loam; Caddo fine sandy loam, slope phase; Bibb fine sandy loam; and Bibb silt loam. These soils are characteristic of a great part of the land in the East Texas Timber Region. They range in acidity from medium to high. From the standpoint of good pastures and good livestock, soil fertility is probably the main limiting factor in this region; however, these soils respond readily to most fertilizers and good treatment.

The shrubby plants on the laboratory consist of French or Spanish mulberry, yaupon, and wax myrtle, but the browse furnished by these is of little if any value. Species of sage grass and many other coarse, rather tall, bunch-type grasses, making up the majority of the native forage coverage, are of little value, except for a short period in the spring. The nutritive value of these tall grasses is considered low at all times. The two sod forming grasses in the native grass coverage are Bermuda and Carpet.

An area of a million or more acres of cut-over pine and hardwood forest land in East Texas is not reproducing much timber. This land carries livestock, especially cattle, but usually the cattle are small in size and poor in quality. With such a vast acreage of land lying more or less idle, the people want to know whether or not it can be converted into good grazing land.

It has been shown that high-grade Herefords will attain normal size and become fat on pastures here, if grazed on an improved pasture, given plenty of fresh water and salt, and maintained during the winter with supplemental feed. Pastures were improved to the point that they would carry in good flesh cows with calves for 260-290 days per year, as compared to 156 days per year on native grass lands.

High-grade Angora goats were secured to observe their adaptibility, and have shown that Angoras can be expected to shear well, but cannot be expected to raise many kids. This leads to the belief that good-shear-

ing-wether goats may be used profitably in this cutover timbered area. Sheep were placed on the station last year to study their value and adaptability. Results this year indicate that stomach worm infestation in this region is a major problem with raising sheep and goats, and must be controlled by frequent phenothiazine treatments and careful management.

Crouch.

Tomato Disease Laboratory, Jacksonville

Tomatoes Practically Immune to Fusarium Wilt

To develop commercially desirable types, work was continued on 96 selections of yellow-flowered, red-fruited tomatoes having the gene for wilt immunity. Several of the hybrids with Marglobe and Rutgers were practically immune to Fusarium wilt and had the horticultural qualities of these commercial varieties in the 4th generation.

White Flowers as a Marker for Wilt Immunity

The genetic characters for white flowers and wilt immunity were combined to use white flowers as a marker for practical immunity to Fusarium wilt. These characters were purified by segregation and selection through 3 generations until all 1074 plants of 13 selections had white flowers and only 5.3% of the plants were wilt-susceptible segregates. No wilted plants appeared in the 4th generation of the selections tested. Of 94 heterozygous plants from yellow-flowered parents, 76.6% had yellow flowers and 23.4% had white flowers in typical segregation.

Varietal Resistance to Tomato Wilt

In addition to the records previously published, Bounty, Early All Red, Firesteel, Marbon, and Victor varieties were found very susceptible to Fusarium wilt. Denmark was the most suceptible as it showed a time-weighted wilt resistance of only 5%. Root-knot seriously decreased the the wilt resistance of 8 commercial varieties of tomatoes, but did not decrease the wilt resistance of the many selections having the gene for wilt immunity.

Yield Test of Tomato Varieties

Eight commercial varieties were tested on land with nearly maximum infestation with the wilt parasite and serious infestation with root-knot nematodes. Pritchard was best with a yield of 4.1 tons of marketable fruit per acre, followed by Pearson with a yield of 3.4 tons per acre. For comparison, yields of these 8 varieties were tested on land practically free from soil inhabiting parasites. Here also, Pritchard gave the best yield with 18.6 tons of marketable fruit per acre, followed by Pearson with 15.9 tons per acre. The green-wrap fruit of Pearson was slightly mottled, but matured more abundantly than did the other varieties in July. The superiority of Pritchard was partly due to early maturity, and gave an additional profit of $70.00 per acre.

Varietal Resistance to Blossom-end Rot

Resistance of tomato varieties to physiological blossom-end rot was tested again on Hume soil. Listed in decreasing order of resistance, the varieties produced the following average numbers of fruits with blossom-end rot per plant: Michigan State 0.4, Prichard 0.5, T707 Marglobe 0.6, Pearson 1.3, T706 Marglobe 1.5, T708 Rutgers 3.1 T638 Rutgers 5.5, Louisiana Red 13.3, Buckeye State 14.4, Riverside 16.9, and San Marzano 67.0.

Effects of Copper Sprays on Marglobe Tomato Yields

Sprays controlled early blight and bacterial spot diseases in a season when an epidemic of early blight occurred. In descending order, the following proprietary materials resulted in profitable increases in marketable fruit, with yields of 14 to 15 tons per acre. Basicop, Fungi Bordo, Copper A Compound, and Copper Hydro "40." Home made Bordeaux mixture burned the tomato leaves severely and decreased the yield of marketable fruit 22%. In 4-year averages, Basicop and Copper Hydro "40" facilitated the largest increases in yields (12 to 17%) of the chemicals tested.

Unusual Genetic Characters in Tomatoes

(1) A lethal gene leaf spot abnormality refoliated 18% of the plants of T585. (2) Prominently downward curled, wrinkled leaves on only one branch of one plant of T617 probably were due to a bud mutation. (3) Garraprihe hybrid tomatoes showed much variation in the fruit of the first generation of the back cross, T566, as only half of the fruits were puffed, and most fruits had hard yellow tops and were wider than Garraprihe fruits. (4) Some hybrids showed extreme dwarfing with bunchey top symptoms due to a dwarfing gene. (5) T660 seeds of Lycopersicon esculentum X L. peruvianum were dwarfed and failed to germinate, so the hybrids were sterile. (6) Prominent stripes and pits in the peel of fruits of T560 apparently were inherited. (7) T633 segregated for color of immature fruits as most plants had green fruits but many plants bore only white fruits. (8) T519 and T577 had determinate vines ending in large flower trusses with giant terminal flowers having prominent brown abscission lines and cracks in the pedicels which resulted in flower shedding as evidenec of genetic weakness.

Soil Fumigation to Control Crop Pests

In tests with watermelon and okra, 89% of the plants had severe root-knot in soil without fumigation. In contrast, soil fumigated with pentachlorethane (1 T. per A.) produced plants without severe root-knot, soil fumigated with tetrachlorethane (1 T. per A.) similarly produced plants only 0.6% of which had severe root-knot, and fumigation with xylene (1 T. per A.) resulted in severe root-knot on only 3.2% of the plants. These chemicals apparently penetrated knotted tomato roots in

the soil better than chloropicrin, as fumigation with 480 lb. of cholorpicrin per acre controlled only half of the root-knot infestation. None of the fumigants controlled the southern blight fungus *(Sclerotuim rolpii)* in this test. It was necessary to ventilate the soil fumigated with pentachlorethane and tetrachlorethane for 2 weeks before planting.

Improved Fertilizer Drill

To decrease labor and avoid fertilizer burning of tomato plants, an 8-inch buzzardwing blade was mounted horizontally behind the outlet spout of a Cole fertilizer drill. This mixed the fertilizer with the soil without raising the fertilizer near the surface of the ground.

Cotton Varieties Resistant to Wilt and Root-knot

Coker 4-in-1 str. 4 produced a 3-year average of 462 lb. of lint per acre in sandy soil abundantly infested with the wilt parasite. The staple length averaged 1 1/16 in. In sandy soil that is abundantly infested with root-knot nematodes and the wilt parasite, the plants showed minimum injury by root-knot and only 0.3% of the plants wilted, while 72% of the Mebane cotton wilted in adjacent rows. Coker 4-in-1 and Coker 100 W.R. str. 39S include strong resistance to the combination of wilt and root-knot with other superior agronomic qualities and thus they promise to be valuable in East Texas.

Two Kinds of Resistance to Cotton Wilt as Affected by Root-knot

There appears to be 2 kinds of resistance to Fusarium wilt of cotton in relation to the effects of the root-knot nematode. One kind of resistance is greatly decreased by root-knot as shown by Miller 610 and Stoneville varieties. The other kind of wilt resistance remains strong despite root-knot as in Coker 4-in-1 str. 4. Resistant varieties contrast with varieties such as Acala and Mebane that are susceptible to both wilt and root-knot.

Preferable Varieties of Wilt Resistant Cotton.

In the tests for the last 5 years, the following varieties gave the largest yields of long staple cotton: Coker 100 W.R. str. 39S, Coker 4-in-1 str. 4, Tifton Dixie Triumph, Miller 610, Dixie Triumph 12, Dixie 14-5-2, Delfos 425, Cook 144-68, and Daltapine 12.

Control of Damping-off of Cabbage

Under conditions favoring damping-off, cabbage seed treated with 2% Ceresan produced a practically perfect stand of seedlings, seed treatment with Vasco 4 (zinc oxide) gave nearly as good results, seed treated with Cuprocide produced half enough seedlings, and untreated seed produced only 1/4 as many plants as did the seeds treated with Ceresan.

Susceptibility of Cowpeas to Root-knot

In the test for resistance to nematode root-knot, 52% of the Whippoorville cowpea plants had severe root-knot, 46% of the Conch cowpea plants had severe root-knot, while none of the *Crotalaria spectabilis* plants had root-knot.

Young.

SUBSTATION NO. 12, CHILLICOTHE

Substation No. 12, located four and one-half miles south and one mile west of Chillicothe, Hardeman County, serves a region in the upper Red River Valley where cotton, wheat, and sorghum are the principal crops, and is operated cooperatively by the United States Department of Agriculture and the Texas Agricultural Experiment Station. The soils of this part of the Rolling Plains area are predominantly of the Vernon, Foard, Abilene, and Miles series. The average annual rainfall at this point is 25 inches. During the early years an important phase of the work consisted of testing crops newly introduced from foreign countries and this early work resulted in the introduction of Sudan grass and the grain sorghums hegari and feterita and in the distribution of Dwarf yellow milo. Reliable information on the procedure in crop production and soil management is being collected, and varietal and cultural experiments are being made with all the important crops. Some attention is being devoted to vegetables and fruits for production in home gardens and orchards and to ornamental plantings of trees and shrubs.

The unique feature of this station is the investigations with sorghums, where the most complete nursery of both forage and grain types of sorghums in America is maintained. An intensive study of sorghum inheritance is under way and the production of new and superior varieties is the aim of an inclusive breeding program.

The precipitation in 1941, 47.25 inches, was the greatest ever recorded at this point.

Experiments With Sorghums

(In Cooperation with the Bureau of Plant Industry, U. S. D. A.)

Sorghum Variety Test: On account of an unusually heavy infestation of Chinch bugs the production in this test during a very favorable season from the standpoint of rainfall was only about normal. Yields, therefore, were quite largely a reflection of resistance to Chinch bugs.

The pure milos produced practically nothing in the June planting. Of the double dwarf types, that are used for combining, the Club x Day hybrids from the Lawton (Okla.) Experiment Station and which are extremely Chinch bug resistant produced 20 bushels per acre when Wheatland produced only 11. Bonita, a new dwarf variety, being distributed from this Station, having feterita, kafir, and hegari parentage, produced

31 bushels. Varieties that produced as much as 30 bushels per acre were Ajax, Bonita, Manko, Maizola, Darso, and Club.

The outstanding sorgo varieties in forage production were Sourless, Honey, two White African x Sumac hybrids and one White African x Orange hybrid. These varieties all produced in excess of 4 tons of air-dry forage per acre.

Yield of Pythium Resistant Strains: The heavy rainfall of the early spring delayed the planting of grain sorghum until late in the season, and Pythium arrhenomanes, the milo root rot disease, was not as much in evidence this year, however, Chinch bugs were numerous. Darso has both Pythium susceptible and resistant strains and is also quite resistant to Chinch bugs. Pythium resistant Darso produced 35 bushels per acre while susceptible Darso produced 8 bushels or 23 percent as much as the resistant strain. Pythium resistant strains of Dwarf yellow milo, Sooner milo, White milo, Early White milo, Day milo, Wheatland, Day, Colby milo, Darso, and Sumac are now available. Varieties such as kafir, feterita, hegari, etc., are resistant to this disease.

A Pythium susceptible strain of Sumac produced 1.65 tons of dry forage per acre while a resistant strain produced 2.85 tons, or a loss in yield of 42 percent.

Sorghum Breeding: This phase of the sorghum work is reported on under Inheritance and Improvement of Sorghum in the Agronomy section of this report as is also the Sudan grass breeding work.

Cotton Experiments

Cotton Variety Test: Rainfall was unusually heavy in 1941 and the cotton crop was planted late. This late planting probably accounted in part for the great differences in production among varieties. The leading varieties in yield were Half and Half, Deltapine 12, Stoneville 5, Lockett 140, Western Early, and Nucala. Half and Half produced 647 pounds of lint to the acre and the other varieties produced between 555 and 532 pounds.

Cotton Breeding: Two varieties now in commercial production are the result of selection work at this Station. State Certified seed of Mebane 140 can be procured under the name of Lockett 140 and seed of Mebane 141 can be obtained under the name of Western Prolific. Registered seed of Mebane 140 is being produced on the Station.

Angular Leaf spot is a bacterial disease that has done great damage to the cotton crop in West Texas during recent years and which was particularly damaging in both 1940 and 1941. Resistance to the disease has not been observed in American varieties but exists in Asiatic species. Hybrid material received from Division of Agronomy was found to contain resistant plants and it seems that it should be only a matter

of time until adopted varieties resistant to this disease should be obtained. The value of such a resistant variety would justify considerable work being done.

Experiments With Corn

Golden June Corn Breeding: Breeding work with the Golden June variety was completed in 1941 as it appears that the present process is no longer making improvement in grain color or in obtaining softer seeds. This variety produced more grain than any other commercial variety in the 1941 variety test but several bushels less than the better hybrid varieties.

Corn Variety Test: Texas hybrid varieties were better in production than either northern hybrids or adapted commercial varieties. The Texas hybrid varieties produced in the neighborhood of 25 bushels and the commercial varieties with the exception of Golden June produced less than 20 bushels. The average expected percentage increase of hybrids above commercial varieties was obtained at Chillicothe this year.

Small Grain Experiments

(In Cooperation with Bureau of Plant Industry, U. S. D. A.)

Wheat Variety Test: The winter wheat crop of 1941 was one of the poorest on record. The crop which was so promising at one time was almost destroyed by a combination of armyworm infestation and diseases of leaf rust and leaf spot. Clarks' Blackhull was one of the poorest varieties in 1941 and Tenmarq was one of the best.

Comanche, is a new smut resistant variety that is being increased for distribution. It is an improved Tenmarq as it resembles that variety which is one of the parents, but Comanche has more leaf-rust resistance and is slightly heavier in test weight than Tenmarq. The milling quality of Comanche is entirely satisfactory.

Winter Wheat Nursery: One hundred and eight strains and varieties were included using seed obtained from the Denton Station. An inclusive plant breeding program is being conducted by the Division of Cereal Crops and Diseases of the United States Department of Agriculture in cooperation with the various states and this nursery is being grown for the purpose of testing the many superior strains that have been produced at the Denton Station and in other States. The breeding program has for its aim the production of good filling varieties that have good production, resistance to rust and to smut, and resistance to lodging and shattering.

Barley Variety Test: The results of the past three years indicate that the smooth awned variety Texan or the rough awned variety Wintex, both of which can be planted either in the fall or spring, should be grown rather than the Tennessee Winter or Missouri Beardless varieties. The

average production for the three years of the better varieties is between 25 and 30 bushels.

Safflower: Safflower (Carthamus tinctorius) is an oil-bearing seed crop native to India that has possibilities as a new cash crop in West Texas. It has been grown for two years with satisfactory production in each year. Seed of 45 pounds test weight was produced in 1940 but in 1941 a Septoria leaf-spot disease killed the plants about ten days prior to maturity, which resulted in seed that weighed 38 pounds to the bushel and contained 150 pounds of oil to the ton rather than the expected 300 pounds

A planting made in October 1940 failed to withstand satisfactorily a temperature of 19 degrees that occurred in November, December, January and February plantings all grew well but were not subjected to any severely cold weather. March and April plantings failed on account of insect damage.

Rates of planting between 20 and 60 pounds to the acre all produced about the same amount of seed. A rate of 10 pounds, however, failed to produce a satisfactory stand in 8-inch drills. Twenty pounds per acre is sufficient seed to plant in close 8-inch drills. The crop can be grown in twenty-inch rows if desired and in such a case 10 pounds of seed per acre will give a satisfactory stand.

The crop was harvested satisfactorily with a combine. The average two-year production of 800 pounds would make the crop about as valuable per acre as a wheat crop and the cost of production of the two crops is about the same.

The oil has been successfully extracted from the seed with cotton seed crushing machinery. The oil is edible but also has properties that make it a valuable oil in paint. Quinby.

SUBSTATION NO. 14, SONORA

Substation No. 14, Ranch Experiment Station, is located on the line of Edwards and Sutton Counties on paved Highway No. 55 and comprises 3461.6 acres. The elevation is approximately 2400 feet above sea level. The average annual rainfall over a period of 23 years is 24.34 inches. This year we had 28.37 inches which is 4.03 inches above normal. Most of the rain received this year fell through the months of February to October inclusive.

All of this station except sixty acres is used for grazing purposes. The sixty acres is used only for producing feed crops to supplement the range during adverse range conditions.

This station serves the Edwards Plateau region of the State where sheep, goats and cattle are the predominating agricultural resources.

The work embraces three main lines of endeavor as they apply to this particular area. Livestock disease investigations, particularly the dis-

eases of sheep and goats, animal breeding studies and range management investigations.

Cultivated Crops, Shrubs, Flowers and Vegetables

No experimental work is attempted on the production of feed crops. But good yields of sorghums are obtained about four years out of five. This year it was advisable to graze and summer fallow the cultivated fields in an effort to reduce Johnson grass infestation.

Very little effort is made to have vegetable gardens but if water is available radishes, spinach, onions, beans, beets, carrots, okra, turnips and potatoes can be grown successfully. Tomatoes are invariably killed out by a disease believed to be wilt.

Spineless Cactus

The spineless cactus field which was grazed by sheep in 1938 to control bitterweed trouble on the range has made considerable growth since that time but it is being damaged by insects and disease. It is doubtful if it will ever be as productive as it was before it became grassed over between the rows.

Bitterweed

The winter of 1940 and 1941 was not favorable for the growth of bitterweed. The fall of 1940 was dry, with the result that practically no bitterweed was germinated until February and March of 1941 when there was adequate rainfall. These weeds, coming that late, caused very little trouble among livestock and it was six weeks to two months later than usual.

The soft chess grass *(Bromus mollis)* was hauled out stalk and all to the bitterweed hazard areas around headquarters in June, 1940. This germinated to an excellent stand and afforded excellent grazing during the winter of 1940-1941. It is quite probable that this grass would be of much benefit in the control of bitterweed on hazard areas if it were so that we could protect it from grazing periodically. It did not reseed itself under continuous grazing but did reseed itself on excluded areas. Approximately 1200 pounds of the Rescue grass seed that was planted in depressions and old lake beds during the summer of 1940 where bitterweed was the predominating vegetation, germinated to an excellent stand and afforded considerable grazing during the winter of 1940-1941. This grass is native and reseeded itself under heavy grazing. It shows a good stand on the hazard areas at the present time and is furnishing good grazing. It would, of course, be more effective in crowding out bitterweed and would afford more grazing for livestock if conditions were so that we could rest it periodically.

Where deferred grazing was practiced from February until June in 1937, 1938 and 1939, desirable winter growing vegetation has shown

450% increase. Deferred grazing in this pasture was not practiced this year nor last, and the pasture was kept stocked with sheep. Even so, desirable winter growing plants were in such aboundance that a large portion of them went ahead and produced good seed crops. One large lake bed in this pasture that was practically 100% covered with bitterweed five years ago is now almost totally covered with Buffalo grass turf. It is definite that deferred grazing contributed materially to this change.

Bitterweed Spraying Tests

The arsenite and arsenate sprays were not satisfactory, but the lowest strength of arsenic acid used was 100% effective. Two hundred gallons of water, to which was added ten pounds of arsenic acid (liquid form) was sufficient to kill 1-1/3 to 1-1/2 acres of solid bitterweed, with very minor injury to grass, when applied with a power sprayer operating at 100 to 150 pounds pressure. Apparently, low atmospheric pressure does not affect the results in killing bitterweed with arsenic acid, while with calcium chlorate it is a determining factor.

One location which was sprayed with arsenic acid was covered with bitterweed and had been a bitterweed hazard area for years. In November of 1941 we harvested 1.67 tons of turf grass from this area. It had not been grazed since May 1st.

Maintaining Sheep on Bitterweed Range

For five years sheep have been grown successfully (we have successfully fed grown sheep) on bitterweed range by supplementing the range with sorghum silage over which from 1/4 to 1/3 pound of cottonseed meal per head was sprinkled. The same success cannot be obtained with lambs (if they are) mixed with grown sheep because they are too timid to go up to the troughs to eat their portion of the silage. If lambs are fed in a pasture to themselves, and are taught to eat the silage and cottonseed meal, (a minimum amount of lime) bitterweed poisoning will develop among them.

Animal Husbandry Investigations

Inheritance of the Ridgling Characteristic in Goats

As previously reported, very rigid selection was started in 1937 against the cryptorchid or "ridgling" defect of Angora goats in the Ranch Station stud flock. This has been continued and much progress has been made. The 1941 kid crop included *no* ridglings. During the 25 years the flock has been in existence there were only four years when no ridglings were produced. Two of these years are included in the last five years since the rigid selection has been in effect. During the first 20 years 6.7 percent of the males were ridglings, compared with 2.7 percent for the last five.

One buck from stud flock at the Ranch Station and one crossbred buck raised at the F. and B. station have been tested during the year at the F. and B. by breeding them to "ridgling-bred" females, and both were found to be carriers of genes for the defect.

Warwick, Dameron, and Jones, (J. M.).

Inheritance of Type in Angora Goats

This study which is being continued indicates that acceptable fineness of fiber may be produced by either ringlet or flat-lock types, even though there seems to be a general tendency for the ringlet and R. and F. (sometimes called web lock) types to be slightly finer. Many goats lack fullness of mohair tip. In such cases the lock assumes either a triangular shape or the outer part of the length may be reduced to a small whiplash shaped lock. In either case weight of fleece is reduced, and more waste ensues in the combing process when manufactured. This is present in both ringlet and flat-lock types but seems to be more prevalent in the flat-lock type. Jones, (J. M.), Dameron, Warwick, and Davis.

A Study of the Inheritance of Skinfolds on Rambouillet Sheep

(In cooperation with U. S. D.)

In order to more effectively study the genes responsible for skinfolds, Corriedale ewes were bred to heavy C and B type Rambouillet rams. The Corriedale mothers were free from skinfolds. Six different Rambouillet rams used varied from 56 to 160 skinfolds with an average of 100.17. The 43 head of F_1 progeny, which have been studied in detail to date, varied from 1 to 55 and averaged 14.67. Considering each sire as 100, these F_1 animals varied from 1.25 to 67.80 and average 17.50. These F_1 animals were mostly light C, and two of them being classified as heavy C and light B respectively.

Rambouillet rams were bred to F_1 ewes to produce back-cross progeny. Twenty-seven of these 3/4 Rambouillet progeny varied from 1 to 48 in skinfold value. In this limited number none had as heavy skinfolds as their Rambouillet sire. The heaviest folded one had 81.36 percent as much skinfold as the sire. The skinfold values for this group averaged 19.81 in comparison to 14.67 for the F_1 progeny.

A few F_2 progeny have been studied. They vary from 1 to 29 in skinfold value. The 16 head average only 7.44. The low value and relatively narrow range of values is probably due to the very small number; and to the fact that the F_1 sire used had the very low skinfold value of 9.

Three back-cross lambs from Corriedale ewes and an F_1 ram were each almost devoid of skinfolds.

These observations point to the high degree of apparent dominance of the smooth over the more wrinkly type. On the other hand, the occurrence of a few rather wrinkly lambs in the F_1 generation suggest that the

phenotype may be due in part to complementary genes. It is much more important to know the type of the parents of and to have a progeny test for a smooth ram than for wrinkly rams. This holds true for both crossbreds and Rambouillets.

Jones, (J. M.), Warwick, Dameron, Davis, McPhee, and Spencer.

Bitterweed Range Station

(Cooperating with the University of Texas)

The 3160 acres of University land between Ozona and Barnhart, Texas, which was set up for cooperative bitterweed and range study between the University and the Experiment Station during the spring of 1938, has now provided four years study of results of the work on this program. The work consists of comparing different systems of pasture and livestock management with sheep and cattle as they relate to animals and to range vegetation production. The highest production for wool per animal this year was again in the pastures where we practiced rotative grazing with sheep and cattle every three months. The wool production in pastures where we practiced continuous grazing with sheep and cattle followed closely that of the rotative grazing plans with the same classes of livestock. The lowest wool production was in the pasture where sheep only were run on a continuous grazing plan. The average weaning weights for the lambs raised on this station ranged from 83 pounds in Pasture D, sheep and cattle continuous for the heaviest, to 64 pounds in Pastures I and K sheep and cattle rotated for the lightest. Pastures F, G, and H, on a 3-pasture rotative grazing plan, produced 70-pound lambs. Pastures A and B, rotated with sheep and cattle, had 65-pound lambs while Pasture P, continuously stocked with straight sheep, had 66-pound lambs.

For the cattle, the heaviest calves produced this year were in reserve Pasture C (429 pounds) which was carrying the cattle for Pastures A. B (sheep cattle rotated) and D (sheep and cattle continuous) and had no other livestock. This was followed closely by Pastures L and M (cattle rotated) which were on a deferred grazing plan. Pasture O, which is on a continuous grazing plan with straight cattle, produced 35 pounds per head lighter calves than did C, reserve and 33 pounds per head lighter calves than Pastures L and M (cattle rotated). The highest percentage of calf production was in Pasture C (reserve) 100%), followed in order by Pastures O, (cattle year long) with 85% and Pastures L and M (cattle rotated) with 76%.

The behavior of the vegetation in the pastures will be reported on by the Department of Agronomy under Mr. R. L. Hensel and George Warner.

Bitterweed Pulling

During May of this year we destroyed the bitterweed crop in Pasture E (catch all trap) by pulling it out by manual labor. The cost of pull-

ing bitterweed in this pasture was $3.24 per acre in 1940 as compared to $4.67 for this year. Pasture D, (cattle and sheep continuous) where the bitterweed was pulled in 1940, was not pulled this year on account of being too dense in large hazard areas. We pulled the bitterweed on 90 acres in Pasture N (reserve) at a cost of $5.69 per acre. This cost is prohibitive and resulted from the bitterweed's being mixed up with a dense growth of other vegetation.

Feed for Livestock

On account of the type of country on which this station is located, some supplementary feed to sheep and cattle would be advisable every winter whether there is a bitterweed crop or not. Due to heavy bitterweed infestation this winter supplementary feeding to sheep was essential from December 16, 1940 to March 30, 1941.

The sheep from Pastures A and B (cattle and sheep rotated) showed some bitterweed poisoning on December 18, which lasted until March 19. Pasture P (sheep continuous) sheep got sick on February 18 and the trouble lasted until March 6. The sheep from Pasture D (cattle and sheep continuous) showed no symptoms of bitterweed poisoning. Pasture G (3 pasture sheep only, rotated with F and H) had the greatest amount of trouble and this lasted from February 12 until March 16. All of the sheep on the station were given three pounds of sorghum silage per head, to which was added 1/4 pound of corn for 52 days and then 1/3 pound of cottonseed meal for 45 days. This kind and amount of feed controlled the bitterweed trouble for the rest of the danger period except in Pasture G (part of three pasture rotation) F-G-H, where the trouble was prolonged, due perhaps to some other contributory cause.

During December 1940 all of the cattle on the station were put on two pounds of 16% protein cubes per head, which amount they received daily until January 4 when the ration was increased to three pounds per head for 52 days. From that time until March 22 the cattle were given 3 pounds of cottonseed cake per head daily. These supplements maintained satisfactory conditions among the cattle for the winter and during the calving season, February 1 to April 30.

Feed Production

Our feed crop on the 41 acres devoted to crops was excellent, as compared to a practical failure last year. Two hundred tons of silage and ten tons of maize were harvested from the first crop. We produced a second crop of ten tons of maize, 4000 bundles of cane, 6,000 bundles of feterita and 2,500 bundles of hegari. Dameron.

Bitterweed Control Studies

The field work in the pastures at Substation No. 14 was done for the most part at a date later than usual. The most striking result this year

was the great success in using the native rescue grass as a control against the growth of poison bitterweed. It is realized that good results with rescue grass are obtainable only in those seasons when rainfall is favorable. In another comparable area a seeding was made with another species of brome grass, *Bromus commutatus* Schrad. As compared to *Bromus catharticus* Vahl, rescue grass, this grass did not give the dense carpeting growth and while there was marked evidence of control it was far short of that observed for the rescue grass. In contrast also to rescue grass this grass was killed out by grazing and did not reproduce, except in exclosures.

Range conditions were favorable this year on The Texas Range Station, and the growth of herbaceous vegetation was of remarkable luxuriance and density. Two features in particular characterize this season. One of these consisted in the very great abundance and the unusually large growth of the various annual grasses. The other consisted in the great and well-distributed abundance of an annual species of broomweed, *Gutierrezia dracunculoides* (DC.) Blake, together with the very vigorous growth of the plants, averaging about three feet in height as compared to its usual height of about one foot. In those pastures where sheep were grazed during the period of from December to March this annual broomweed was absent, or essentially so, the few plants showing up being late ones of small growth. Due to the density of growth of this plant it is possible that it may prove to be of importance in the control of poison bitterweed by shading out these seedlings. In lake-beds on a neighborhood ranch it was observed that great success was obtained in replacing a herbaceous vegetation consisting almost entirely of poison bitterweed through the means of seeding with Johnson grass and Bermuda grass in combination. Conditions were favorable for the growth of both of these grasses and the success gained was remarkable. In lake-beds or depressions where buffalo grass exists in spots there is some spread of this grass under conditions of moderate or of deferred grazing and this spread is greater in the more favorable seasons of growth, such as obtained this year. In the spots or areas above the lake-beds bare of perennial grasses there is little or no evidence that any of the perennial grasses are establishing themselves therein of their own accord. It may be that some of the bunch grasses will prove to be more adaptable than the turf grasses for reclaiming these areas now devoid of perennial grasses but which undoubtedly in former times also were carpeted with grass. Cory.

Veterinary Activities

Soremouth (Contagious Ecthyma) of Sheep and Goats

Orders amounting to 923,758 doses of soremouth vaccine were prepared and shipped. Boughton and Hardy.

Stomach Worms (Haemonchus Contortus) of Sheep and Goats

No abnormal variations were found in either haeomoglobin estimations or red and white blood cells counts of sheep following administration of therapeutic doses of phenothiazine in aqueous suspension.

One ewe in advanced pregnancy dropped a dead lamb two days after being drenched with a therapeutic dose of phenothiazine in aqueous suspension. Another pregnant ewe dropped a listless, "dumb" lamb one week after similar treatment while six ewes, all in advanced pregnancy, dropped normal lambs within 2 to 22 days after being drenched with phenothiazine in therapeutic doses.

The eggs of *H. conortus* were absent in the feces of sixteen infested lambs six days after they were each given therapeutic doses of phenothiazine and turned into a known infested pasture. Eggs appeared in the feces of six lambs in 22 days, in nine lambs in 35 days and in one lamb after 56 days. These animals averaged 13.9 lbs. gain each while 17 untreated controls in the same pasture gained an average of 9.8 lbs. per head.

Phenothiazine, given at the rate of .1 gram per pound weight, reduced the fecal egg count of two *H. contortus* infested lambs by 95% within 3 days. The animals were penned in a clean concrete stall where they could not acquire additional infestation. The egg count remained very low for 25 days following treatment.

Turkey red oil showed no anthelmintic efficiency in *H. contortus* infested lambs.

Diphenylamine suspended in turkey red oil and water showed a variable efficiency in killing *H. contortus* in infested lambs, being more efficient in lightly infested animals than in those carrying a large number of worms.

Phenothioxine proved very toxic and of no anthelmintic value when given orally to *H. contortus* infested lambs.

Powdered parachlorodiphenyl reduced fecal egg counts by 81%, 97.8%, 75% and 0% but proved toxic when fed to four *H. contortus* infested lambs. Sodium thiosulphate in aqueous solution, when given at the rate of .6 gram per pound body weight, reduced fecal egg counts by 62.5%, 75%, 60% and 28.5% in four lambs and killed all but a few *H. contortus* in four additional lambs autopsied four days after treatment.

Zinc oxide in water, given orally at rates varying from .1 to .5 gram per pound body weight, reduced fecal egg counts from 88% to 100% and caused a profuse diarrhea which resulted in fleece worm infestations in each of the seven infested lambs treated. Boughton and Hardy.

Hard Yellow Livers of Sheep and Cattle

An extensive outbreak, covering more territory than either the 1931 or the 1937 outbreaks of this fatal disease, was discovered in October of this year. Present knowledge shows that, roughly, the northern halves of Reagan and Upton and the southern halves of Midland and Glasscock Counties comprise the region known as the hard yellow liver "country."

Vegetation surveys brought a dwarf variety of the summer annual *Grindelia squarrosa*, under suspicion. Alcoholic extracts of *G. robusta*, a related species, (*squarrosa* was not available) are being fed to a sheep.

Six sheep, force-fed varying amounts of the leaves, flowers or seeds of *Senecio longilobus* during the last four years (one in 1937, two in 1938 and three in 1939) and held under field observation were released as healthy in August.

Feeding tests of the cyanogenetic spurge, *Stillingia treculeana*, in very small daily doses, proved extremely toxic for four sheep but caused no lesions similar to those found in hard yellow liver disease.

Fifty-nine yearling lambs were placed in known "dangerous" pastures in December. Some of these animals will be autopsied at thirty days intervals to determine whether they have contracted the disease.

Boughton and Hardy.

Sporadic Bovine Encephalomyelitis.

Four field outbreaks of this subacute disease of calves were investigated.

Subcutaneous, intraperitoneal and oral administration of infectious material (brain, liver, spleen, kidney and lymph gland tissues, abdominal and pleural fluids, urine, nasal mucous and blood secured during the febrile stage) transmitted the disease to calves and Guinea pigs but not to sheep, white mice, rats or rabbits.

Two attempts to infect Guinea pigs with spinal fluid from typical cases in calves were negative.

Intraperitoneal injections of a saline emulsion of blue lice *(Linognathus vituli)* taken from a moribund calf, failed to transmit the disease to Guinea pigs.

No microorganisms capable of reproducing the condition were isolated from either field or experimentally-induced cases.

One spleen and liver tissue bacteria-free filtrate of two brain tissue and three spleen and liver tissue filtrates tested, transmitted the disease when injected intraperitoneally into Guinea pigs.

The virus remains alive 28-40 days when infective tissues are stored at 40° F, and for at least 184 days when such tissues are kept frozen.

Calves and Guinea pigs, recovered from the disease, resisted large doses of infective material with the exception of one Guinea pig (of eight tested) which died in ten days.

Four Guinea pigs, immunized against the eastern strain of equine encephalomyelitis, succumbed to bovine encephalomyelitis within 5 to 7 days when injected intraperitoneally with ineffective material.

Boughton.

Miscellaneous Work.

Infectious Entero-toxemia (Milk Colic) of Lambs. The immunizing value of a zinc chloride-precipitated toxoid of the causative organism,

Clostridium welchii, type D, was tested in field trials conducted on four ranches. A total of 1435 ewes were each injected with 1.5cc of the toxoid approximately one month before lambing time; as controls 2665 pregnant ewes were left untreated on the same ranches. The test ewes dropped 1322 lambs of which two (.22%) died of entero-toxemia while the controls gave birth to 2656 lambs of which 14 head (.83%) succumbed to the disease.

Feeding Trials of Suspected Plants.

Acacia Berlandieri (Guajillo.) A sheep, which developed "limberleg" during 1940 after consuming the leaves and flowers of this plant exclusively for 291 consecutive days, recovered within three months when fed alfalfa hay and cottonseed meal only. Started on a daily ration of *A. Berlandieri* leaves exclusively in April, this animal developed typical symptoms of "limberleg" on the 100th day of the test and died on the 132nd day.

An Angora nanny was fed the leaves and a small quantity of the fruit of this plant exclusively for 499 days during 1940-41, except for four months (Jan., Feb., Mar. and April, 1941) when it was given a daily ration of alfalfa hay and cottonseed meal. Typical symptoms were manifested on the 494th day and the animal died on the 499th day.

An Angora kid subsisted on the leaves of this plant exclusively for 446 days (during parts of 1940-41). It died of malnutrition on the 446th day.

Verbesina nana. This plant did not prove toxic to a sheep force-fed 4.5% body weight of the leaves during 3 consecutive days.

Conyza Coulteri. Three percent of the body weight of the fresh green leaves of this plant, force-fed to a lamb, proved fatally toxic in 3 days.

Laboratory. A total of 813 specimens, diagnostic and experimental, were handled during the year. Boughton and Hardy.

SUBSTATION NO. 15, WESLACO

This substation is located in the Lower Rio Grande Valley, midway between the cities of Weslaco and Mercedes on the Main Valley highway. The four counties forming the Southernmost part of the state are served by this field station. A wide variety of agricultural commodities are produced in quantity in these counties, but citrus fruits, vegetables, cotton and livestock are the most important crops. The expansion of the livestock industry has created renewed interest in feed and forage crops and in high protein, oil producing crops such as soybeans, flax and peanuts.

Experiments with Citrus Fruits

Soil Management Studies: The timely and proper use of irrigation water, the use of cover crops or mulchs during the hot summer months, and the moderate use of nitrogen concentrates appear to be most important in the management of aged citrus orchards. Adequate wetting of the soil in the root zone and avoidance of water logging are both highly important. Mulching the soil with hay appears to be more beneficial than the use of complete fertilizers.

Citrus Varieties and Rootstocks: It now appears that certain varieties of oranges are fully as productive as grapefruit, when grown on well adapted soils. Early varieties, such as Hamlin and Joppa, considerably outyielded late varieties of the Valencia type. Ruby grapefruit is a highly desirable variety, but it seems that the highly productive, precocious clonal strain may need a more vigorous understock than sour orange if growers of this variety are to avoid the small fruit problem.

There are a number of new and noteworthy types in the variety nursery, including several plant immigrants and three U. S. D. A. tangelos; Mineola, Lake and Umatillo. These Mandarin type fruits have high flesh and juice color and excellent quality.

Progeny Studies: Production records of twelve lots of progenies, propagated with buds from parent trees having highly variable performance records, were quite similar. Clonal selection does not appear to be reliable way of increasing the yield of asexually propagated grapefruit trees over normal for the variety in this environment.

Citrus Fertilizer Test: Nitrogen is the most important element in the fertilizing of bearing grapefruit trees, but 16-20-0 fertilizer appears to be slightly superior to sulfate of ammonia. Sorghum hay at the rate of 150 pounds per tree was more beneficial than 20 pounds per tree of 5-15-5 fertlizer. Friend.

Citrus Crosses: Interspecific and intervarietal crosses were made involving several kinds and varieties of citrus. Seedlings growing from crosses of previous seasons include: intervarietal orange crosses, tangelo x tangerine, tangelo x grapefruit, tangelo x orange, orange x lemon, and orange x grapefruit hybrid combinations. These seedlings are not yet of bearing age.

Citrus Variety Descriptions: Detailed descriptive notes were continued on the standard and newer sorts of citrus. The results of several seasons were published as a station bulletin during the year. Wood.

Citrus Insects Incidence: For a period during the year the Cottony cushion scale *(Icerya purchasi)*, Soft scale *(Coccus hesperidum)*, with the resulting sooty mold, and the Florida red scale *(Chrysomphalus aonidum)*, were abundant enough to cause general concern. Natural enemies reduced these pests to inconsiderable numbers without the aid of applied control measures. Riherd.

Florida Red Scale (Chrysomphalus aonidum): Toxicity tests with kerosene emulsion plus Derris resins were non-productive of results because natural enemies destroyed a high percentage of the scales. 2 (4 tertiary-butylphenoxy) ethanol used as a solvent for Derris resins caused defoliation of orange trees. Riherd.

Population Studies of Rust Mites (Phyllocoptes oleivorus): The rust-mite population was lighter in 1941 than either 1939 or 1940. The peak of the population in 1941 occurred during the first week of June, which is approximately three weeks later than in 1939 and 1940. Riherd.

Citrus Stem-end Rot: Sodium tetrachlorphenolate in ½ percent solution and iodine 0.04 percent in weak potassium iodide added to 5 percent borax, as non-toxic chemical treatments, both gave better control of stem-end rot in lemons than the standard borax and sodium metaforate treatments. Merthiolate, used in all experiments, has consistently given superior control. *Colletotrichum gloeosporioides* was isolated from an unusual leathery type of lemon stem-end decay that caused 5 percent loss in fruits that had received sodium metaborate treatment.

Mineral-deficiency Chlorosis: Soil applications of Sulphur and sulphur-compost gave perfect control of severe chlorosis in 58 trees in a citrus nursery. Alumium sulphate did not give satisfactory control. Sulphur and zinc sulphate soil applications on old trees that were 50 percent chlorotic with zinc-deficiency symptoms, brought about quick recovery. The healthy condition remains two years after application.

Nitrogen-starvation Chlorosis: A general starvation chlorosis in young and old citrus groves, manifest by a gradual yellowing of the leaves including the veins, occurred abundantly during the summer, following excessive rainfall in spring and early summer, and has continued into the winter. Striking recovery was brought about in two experimental groves by summer applications of nitrogenous fertilizers.

Pruning-wound Protectants: Most desirable of several materials tested on hundreds of pruning wounds were mixtures of 60 percent low-melting point asphalt with 40 percent anthracene oil or carbolineum, with disinfectants added. Suitable disinfectants were phenol 2½ percent, tetrachlorphenol 1 percent, or pentachlorphenol 1 percent. These mixtures are completely toxic to fungus growth, non-injurious to the cambium, long lasting, economical, easy to mix, and easy to apply. Godfrey.

Date Variety Adaptability Studies: There are 196 established palms of 25 varieties on the station. Of this number, 76 are from Iraq, 2 from Arizona, and the remainder from California. Among the more promising sorts are Khadrawy, Halawy, Maktoom, and Amir Haj. (In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture.)

Propagation and Fruiting of Date Palms: Fifteen offshoots comprising eight varieties were sent to Substation No. 19 at Winter Haven, Texas. One

hundred and seventy-one offshoots comprising three varieties were removed and sold for a commercial planting at Laredo, Texas.

Work was continued on the artificial ripening of dates. Fumigation with a mixture of one part carbon tetrachloride and three parts ethylene dichloride besides killing all insects present also improved the quality and appearance of the dates.

Papaya Adaptability Studies: Papayas from South America, South Africa, Hawaii, Florida and Texas are under observation. Breeding and selection work is being carried on with both monoecious and dioecious types. Wood.

Strawberry Variety Nursery: Missionary was slightly more productive and matured its crop earlier than Ranger and Rio Grande but was not equal to these varieties in table quality. Alamo was the most productive variety, but matures its crop too late to be commercially desirable. It is an excellent variety for the home garden. Friend.

Strawberry Chlorosis: Early summer chlorosis in strawberry plants was reduced to 20 and 25 percent by soil acidification with acid peat and sulphur applications, as compared with 48 percent chlorotic in non-treated controls. Godfrey.

Avocado Propagation: Satisfactory understocks of the Cuban type have been found and several cold resistant varieties of excellent quality are known to be adapted to Valley conditions. An effort is being made to work out a satisfactory method of budding or grafting that will encourage nurserymen to propagate planting stock at a reasonable price. Friend.

Rose Understock Test: **Rosa centifolia** and **R. caudata** gave the highest percent survival over a two-year period, but did not nearly equal the blossom production record of multiflora x bland hybrids. Friend and Ratsek.

Rose Chlorosis: Rose bushes that received sulphur and sulphur-compost treatments during the summer of 1940 continued to have good color throughout 1941, without additional treatments. In a rose garden that showed severe iron-deficiency chlorosis early in the year, all soil applications containing acid sulphur compost gave satisfactory control. Treatments without sulphur, including iron shavings alone, aluminum sulphate, and peat moss were only slightly improved over control plants, which were 60 percent chlorotic, 11 months after the treatments were applied. Godfrey.

Experiments With Vegetable Crops

Cabbage Variety Test: Several of the "yellows" resistant varieties showed up to good advantage this year. Marion Market, All Head Select and Wisconsin Hollander were the most desirable varieties in their re-

spective groups. Enkuizen, Penn State, Ballhead and Wisconsin All Seasons produced very satisfactory yields.

Cabbage Fertilizer Test: The most interesting feature of the fertilizer test was the slightly depressing effect of 11-48-0 ammonium phosphate on total yield and its favorable effect on solidity of the heads. A 6-18-0 fertilizer at 400 pounds per acre increased yields to a marked degree.
Friend.

Cabbage Worms (Autographa brassicae): Derris-sulphur 10-90 gave a higher degree of control than Derris, lethane-sulphur 10-90; Cryolite-sulphur 33-66, or synthetic cryolite-sulphur 33-66. Natural cryolite gave a higher degree of control than did a synthetic cryolite. One percent Vatsol O.S. added to Derris-sulphur dust did not increase its effectiveness.

A rotenone dust composed of 10-90 Derris sulphur gave a higher degree control than either a 10-90 Derris-pyrax or a 2-98 Derris resins-pyrax dust. The 10-90 Derris-pyrax was better than 2-98 Derris resins-pyrax dust.
Riherd.

Cabbage Webworm (Hellula undalis): The cabbage webworm severely damaged cabbage seedlings of the early fall plantings. A 5% rotenone dust was ineffective as a control of this pest. Arsenate of lead-pyrax (25-75), cryolite-sulphur 50-50, and calcium arsenate controlled the cabbage webworm with equal effectiveness.
Riherd.

Harlequin Cabbage bug (Murgantia histrionica): Results of a test to control this pest indicated that pyrocide, a pyrethrun dust, containing .2% pyrethrins is more effective than a Derris-sulphur dust containing 1% rotenone.
Riherd.

Cabbage Alternaria Leaf Spot: Counts made on 8 varieties in a varietal planting at Los Fresnos rated the varieties in descending order of apparent resistance to a severe outbreak of Alternaria leaf spot as follows: All-head Select, Wisconsin All-season, Globe, Penn State Ballhead, Midseason Market, Marion Market, Hollander, Round Dutch. The disease was rapid in development and spread. Artificial inoculations with *Alternaria brassicae* spores showed that penetration of leaves with visible symptoms occurs within 24 hours. Where wrapper leaves of marked heads showed 4 to 8 small specks on Feb. 5th, there were hundreds of specks 1 week later. Airplane dusting with copper-lime in commercial fields failed to give control.

Cabbage black rot: The standard mercury bichloride seed treatment reduced seed germination 29 percent in 2 tests of 500 seed each. When the seed was not well rinsed after treatment the reduction was 60 per cent. A 5-minute rinse was better than a longer rinse. A light spray treatment with 1 to 5000 Merthiolate followed by a quick rinse and then drying reduced germination less than 10 percent.

Crucifer Breeding Test: A large number of cabbage, collards, and broccoli selections were tested, also a number of cabbage—collard crosses. The breeding work is being done at the Main Station, but the adaptability tests and selections are being made.

Cabbage Variety Tests: Standard and new varieties of cabbage were field tested at Los Fresnos and San Benito. Glory of Enkhuizen is still the most desirable sort. All Head Select, Midseason Market and Danish Roundhead show promise.

Cabbage Fertilizer Tests: Various sources of nitrogen and complete fertilizers were used in the Cameron County tests. The danger of over fertilization with nitrogen was observed. Coarse, loose heads resulted from a 400 pound per acre application of material containing 20% nitrogen. The check plats produced 15 tons per acre of marketable cabbage. Moderate applications of nitrogen gave increased yields.

Woods.

Tomato Variety Test: In the replicated test, Stokesdale and Break-O-Day tomatoes produced higher total yields and 40 percent more early fruits than did late varieties like Rutgers and Marglobe. In the single row nursery planting Break-O-Day, Pritchard, Valiant and Stokesdale were the high yielding varieties. Morse 133, Bonny Best, Pan America, Table Talk and Clark's Early were the poorest varieties in the test.

A large number of strains and varieties of tomatoes were tested at Los Fresnos and Harlingen. Rutgers and Stokesdale are the best adapted and most widely used varieties. Valiant and Pearson show promise.

Friend, Wood.

Tomato Crosses: Backcrosses of four Texas hybrids were made with their parental and grandparental types. Crosses involving several of the best adapted standard varieties were made.

Tomato Fertilizer Tests: Significant yield increases were obtained from the application of 400 pounds per acre of an 8-16-0 fertilizer. Neither nitrogen alone nor an 8-16-8 fertilizer gave yield increases

Wood.

Garden fleahopper (Halticus citri) of tomatoes: A proprietary pyrethrum dust containing .14% pyrethrins gave excellent control of this pest on tomatoes in the seed beds at Donna, Texas.

There was no difference in the degree of control with pyrethrums-sulphur, and two proprietary pyrethrum dusts at Mercedes, Texas, containing .15% pyrethrins. These dusts were highly significantly better than a proprietary dust containing .075% pyrethrins and 1.5% thiocyanate.

Control experiments were started late in the season after a large number of adults were present on tomatoes. Two dust applications re-

sulted in approximately 88% reduction of the garden fleahoppers on plats where pyrethrum-sulphur 15-85 was used; 74% where nicotine tobacco dust (10% free nicotine)-sulphur 15-85; and 77% on plats where sulphur alone was used. Riherd.

The results of tests conducted at Santa Rosa, indicated that pyrethrum sulphur; and two proprietary dusts containing .15% pyrethrins were equally effective in controlling the garden fleahoppers on tomatoes. These dusts were superior to a proprietary dust containing .075% pyrethrins and 1.5% thiocyanate. Riherd.

Tomato Fruit Worms (Heliothis armigera): Natural conditions reduced the number of worms again this year to such an extent that no data were secured on tests of materials to control this pest. Riherd.

Corn Variety Studies: Because of the increased interest in hybrid corn, a collection of inbreds and single crosses was assembled and studied during the 1941 season. The more promising inbreds and cross breds are being increased for use in producing hybrid seed for this region. Most of the Station hybrids will have the excellent local variety, Tuxpan, in their pedigree. Adequate shuck covering is a highly important characteristic to consider in the evaluation of corn varieties for the subtropics. Wood, and Friend.

Sweet Corn Varieties for Canning and Quick Freezing: Both yellow and white open pollinated and hybrid sweet corn varieties were tested. The yellow hybrid sorts were the best adapted. Ioana, Ioglen and Iogold A were outstanding.

Sweet Corn Hybrid Adaptability Test: Several Texas sweet corn hybrids, one parent of which was Iowa 45, were tested in comparison with Ioana (P39 x 145). Three of the Texas hybrids are very promising, being equal to Ioana in quality and superior in yield due to increased resistance to corn earworm damage. Wood.

Corn Earworm (Heliothis armigera): Mineral oil, mineral oil plus 1% pyrethrins extract 20:1, and mineral oil plus two percent ethylene dichloride were equally effective in controlling the corn earworm. Mineral oil plus 10% ethylene dichloride killed worms well down into the ear without injury to the kernels.

Arsenate of lead-sulphur 25-75, Derris-sulphur 15-85, and Indalone-pyrax 1-99 gave no protection against the corn earworm. Riherd.

Beet Variety Test: Selections of Detroit Dark Red and Green-top Bunching were definitely superior to Crosby's Egyptian under the extremely humid conditions which prevailed during the early part of 1941.

Carrot Variety Test: The new variety, Streamliner, appears to be a definite improvement over Imperator and Half Long both in appearance and quality. Friend.

Carrot Alternaria Leaf Blight: The importance of crop rotation in the culture of carrots where blight is a factor was demonstrated early in the fall by sharp contrasts in a blight incidence between rotated and non-rotated portions of the field, in 2 separate localities. Rows in a badly diseased field sprayed with Bordeaux 5-2-50 several times during the height of the disease outbreak out-yielded adjacent non-sprayed rows 3¾ to 1. Where the tops were cut prior to the first spraying the improvement was 5 to 1 over the cut but not sprayed. Godfrey.

Onion Thrips (Thrips-tabaci): A mixture of naphthalene and pyrophyllite containing 50% naphthalene was more effective in reducing the thrips infestation than a mixture of a nicotine tobacco and sulphur containing 1½% free nicotine.

Nicotine sulphate 1 part to 1000 parts plus an oxidized petroleum hydrocarbon 1 part to 200 parts gave the highest immediate control of eight spray materials tested. Five days after the materials were applied the infestation was the lowest on plants sprayed with a proprietary rotenone spray. Riherd.

Onion Leaf Blight: A disease tentatively called onion leaf blight (cause not definitely established) manifest by a white spotting of leaves and dying of leaf tips followed by complete leaf collapse, leaving an elongated leaf-free neck and much reduced bulb size, occurred severely in Hidalgo, Cameron, Willacy and Nueces counties. Counts on a hundred plants on two farms just before the usual harvest time showed only 12 percent leaf survival. Godfrey.

Squash Variety Test: Buttercup, Yellow Straightneck and Golden Hubbard are high yielding varieties of excellent quality. Golden Table Queen has excellent quality but is not nearly equal to Golden Delicious in yielding ability. Friend.

Snap Bean Variety Test: Adaptability tests of both pole and bush type snap bean were made. U. S. No. 5 Refugee and the stringless greenpod types of bush beans were promising. Blue Lake and Early Ideal pole beans were high yielders and were of especially good quality.

Edible Soybean Adaptability Test: A number of varieties of edible soybeans were tested. Hokkaido, Green Giant, and Imperial were outstanding as to quality and yield of green shelled beans. Wood.

Potato Variety Tests: Spring plantings were damaged by excessive rainfall but Chippewa produced satisfactory yields under conditions that caused a total failure of Triumph. In the fall tests, both Chippewa and Triumph produced satisfactory yields. Several unnamed seedlings developed by the U. S. D. A. appear to have some promise.

Preceding the potato crop with sweet clover gave marked increases in yield.

Potato Seeding Test: Under the extremely hot conditions which prevailed during September and October, cut seed and grade 3 seed tubers gave poor stands of plants. This is in line with previous experience during hot fall seasons Friend.

Potato Fertilizer Test: Several combinations of fertilizers were tested on potatoes near Los Fresnos. Additions of phosphate alone are indicated for these soils. Complete fertilizers were no better than the checks. Fertilizers containing both nitrogen and phosphate were not as good as phosphate alone. Wood.

Potato Soft Rot: Non-washed potatoes stored dry showed no rot, and thoroughly dried washed lots showed practically none. Various chemical-dip wet treatments produced decay ranging from 3 to 36 percent. Godfrey.

Sweet Potatoes for Starch: In the early planting Key West was the high yielding variety; while O-29881 and 24171 were outstanding in the May planted tests. Yields were not equal to those of last year because of the excessive rainfall during the early part of the growing season which encouraged excessive vine growth. The crop appears to have possibilities as a forage producer even though starch factories are never established in this region.

Sweet Potato Adaptability Tests: Porto Rico and Porto Rico x Nancy Hall from Louisiana produced very satisfactory yields of roots having excellent table quality. Friend.

Experiment with Agronomic Crops

Because of the increasing interest in livestock and also because of the demand for crops for processing, the scope of the agronomic work has been considerably expanded. Adaptability tests with forage crops and oil producing crops were expanded during the 1941 season.

Sorghum Variety Test: The rainy season of 1941 afforded an excellent opportunity to study disease resistance in the standard types of forage plants. Shallu, Honey Sorgo, Atlas Sorgo, Teosinte and Millet were most resistant to leaf-streak disease. Teosinte, Honey Sorgo and Medium Dwarf Sumac produced green forage yield ranging around fifteen tons per acre in two station tests, and made most favorable showings in a cooperative test on the James Cowan farm South of Brownsville. Tifts Sudan (a Sudan x Sorghum hybrid) produced exceptionally heavy yields of forage and should be a valuable ensilage crop for use on irrigated land. Friend.

Effect of Soil Treatment on Forage Yields: The application of gypsum in subsoiler furrows, subsoiling followed by soil drenching, and surface applications of sulphur increased the yields of fourteen out of fifteen varieties of forage crops, which were grown on shallow saline

soil. Surface application of strip mined gypsum were only slightly beneficial and appeared to have a depressing effect on yield in the case of certain crops. Friend.

Disease Resistance in Sudan Grass: Resistance to foliage diseases is the most important characteristic for improved varieties of Sudan in the Gulf Coast region. Several of the new varieties, developed by crossing with disease resistant sweet sorghums, are definitely resistant to disease, but are still too heterozygous to be released. Tifts Sudan was outstanding in yield and disease resistance, but lacks uniformity. Quinby and Friend.

Hybrid Field Corn: A large number of top-crosses were made with inbreds and single crosses on Tuxpan. Three of these combinations show promise. Breeding work is being carried on to develop both white and yellow hybrid Tuxpan types. Wood.

Cotton Variety Tests: Sixteen varieties were grown at two locations in the Valley and six varieties were grown on five different soil types. Coker 100-S5 was the outstanding variety in all of the tests, but Stoneville 2B and Deltapine 12 also made favorable showings. At two locations, where pest control measures were used, yields of the better varieties ranged around seven hundred pounds of lint per acre. These yields were secured during a season when many veteran cotton farmers of the Valley averaged less than half a bale per acre on their 1941 cotton acreage. Heavy spring rains delayed planting and encouraged excessive stalk development, and boll weevils were unusually destructive. Friend.

Cotton Fertilizer Test: On a block of late (May) planted Stoneville 2B cotton, a side dressing of 200 pounds per acre of nitrate of soda, applied at the thinning time, gave an increase of more than 100 pounds of lint per acre, which was twice the increase secured from an equal quantity of 11-48-0 fertilizer, applied in a comparable way. Friend.

Cotton Rotation Test: Where cotton followed sweet clover in the rotation, ten out of the sixteen varieties gave increased yields, while six varieties produced less seed cotton than did plats on land previously planted to a non-legume. Even on the depleted soil, the plants attained abnormal size, but were smaller than those on the clover plats. Friend.

Cotton Root Rot: Bands of sulphur and of sulphur compost placed in the row below the seed level failed to prevent Phymatotrichum root rot in cotton, in an extensive Latin Square experiment. In a rod-row test in which acid (low-sulphur) composts were applied as side dressings at early blossoming time, treated plants survived till the close of cotton picking even though surrounded by plants that were completely dead from root rot. Godfrey.

Winter Legumes. Twenty-seven strains and varieties of clover and forty-seven strains and varieties of alfalfa were grown during the winter

season of 1940-41. Pilca Butta was the outstanding variety of alfalfa, while Canada Melana, (a dwarf branching type of annual white sweet clover) was the most desirable of the clovers. Several Texas selections of Dwarf Huban offer considerable promise as forage plants for the lower Rio Grande Valley. Manke and Friend.

Flax Variety: Hundreds of plats of winter flax were grown during the 1940-41 season and excellent yields were produced by the disease resistant types such as Bolley's, Golden, Rio, G129 and many of the Rio x Giza hybrids. Punjab, Bison and other susceptible varieties failed completely because of disease infection. Rain at harvest time caused lodging and yield records were not secured for all of the varieties.

McFadden and Friend.

Small Grains: Of the 136 varieties of wheat included in the tests only the South American types and Gasta seemed to offer much promise. In a normal season some of the more resistant types would produce good yields of grain that could be used as feed for poultry.

Ranger was the best of the 25 oat varieties used in the rust resistance studied. There will be a market for all of the seed of this variety that can be produced during the next few years.

Abaccus was the only one of the 25 varieties of barley that matured grain under the extremely unfavorable conditions which prevailed during the early part of 1941. Leaf diseases caused almost complete defoliation of most varieties. McFadden and Friend.

Soybean Adaptability Tests: The success attained with the fall planted crop in 1940 made it seem desirable to expand the work with soybeans in 1941. February and March plantings of a large number of varieties gave very satisfactory yields both at the station and on a dryland farm near McCook. Many of the standard varieties produced bean yields ranging from 35 to 40 bushels per acre with some unnamed selections exceeding this figure by a considerable margin. Hayseed, Dunfield, Arksoy, and Macoupin appear to be promising varieties for use on unirrigated land. Biloxi, Palmetto, Georgian, Arisoy and Hayseed are best for forage production or soil improvement.

More than two hundred varieties of soys were included in the fall planted tests. Yields were hardly equal to those recorded for the spring crop but the quality of the crop was excellent. Macoupin was the high yielding variety in the replicated test, but many varieties produced yields ranging around 35 bushels per acre. Forage varieties like Biloxi produced excellent yields of hay just sixty-five days after planting.

Macoupin, Arksoy, Illini, Dunfield and Manchu appear to be reliable standard sorts for fall planting.

Hokkaido Giant Green and Imperial are most excellent table varieties that produced two-ton yields of green shelled beans and about one-fourth that quantity of dry beans. Friend.

Castor Bean Tests. The Red Top or Flowering variety again produced the highest yield of beans (1132 lbs.) but U. S. No. 7 and U. S. No. 4 are more desirable types for general use because of their smaller size and also because they hold the ripe seed with a minimum of loss from shattering.

In a spacing test with the U. S. No. 7 variety, a spacing about like that allowed for corn gave much higher yields of beans and smaller plants than the usually suggested spacing of 6x3 feet.

Yields of 1200 pounds of beans would not be profitable on irrigated lands of this region, even at five cents per pound. Friend.

Miscellaneous Seed Treatment: In connection with a nation-wide co-operative seed treatment experiment, treatment with Spergon (Tetrachloro-para-benzoquinone) more than doubled the stand obtained with non-treated English pea seed; Semesan treatment doubled the yield of red beets. With sweetcorn and spinach no benefit was derived from seed treatment.

Soil Fumigation Studies for Root-Knot Nematode Control: Where fumigants were adequately confined, minimum lethal dosages in fairly dry sandy loam soil, in terms of pounds per acre-foot were: for ethylene dichloride, 1400 pounds; for carbon bisulphide, 1000 pounds; chloropicrin, 500 pounds. In preliminary tests with methyl bromide, 633 pounds per acre-foot penetrated undecayed root galls, killing larvae and eggs.

Disease Resistance Studies in Grain Sorghums and Sudan grass Hybrids: A wide range of grain sorghums showed differences from 75 to 100 percent in freedom from rust, and from 70 to 100 percent in freedom from bacterial streak. Sudan grass hybrids of several strains ranged from 50 to 95 percent free from Helminthosporium leaf spot and from 50 to 90 percent free from bacterial stripe at 2 months after planting. These data influence the selection of strains of Sudan grass hybrids and grain sorghums for lower Rio Grande Valley planting. Godfrey.

TEXAS SUBSTATION NO. 16, IOWA PARK

Substation 16 is located in the Wichita Irrigated Valley. The soil types are of the Miller and Yahola series, fairly typical of the soils of the Irrigated Valley. The average rainfall for the 16-year period, 1926-41, is 32.30 inches. The rainfall for 1941, 58.78 inches, was the highest in the history of the station. Free irrigation water is furnished the station from Lake Kemp and Lake Diversion by the Wichita County Water Improvement District No. 2.

The station is concerned with the production and improvement of general farm and fruit and vegetable crops, with the duty of irrigation water and with the breeding and feeding of sheep.

General Crop Production

Cotton Variety Test: Planting was delayed by excessive rains and yields were only about 35 percent of normal. Deltapine No. 14 (44-51) made the highest yield of 176 pounds of lint per acre. Other yields in the first 10 varieties were: Hi-bred, 175 pounds; Western Early, 174; Lankhart x Mebane, 173; Stoneville 5A, 171; Bryant Mebane, 163; Delfos 531C, 162; New Boykin, 154; Harper BL Strain, 152; and Ferguson, 406, 150. Two of these high-ten varieties have been included in the test for over 10 years, and because of their high comparable yield rating are recommended for general planting in this valley. These are Ferguson 406 and New Boykin.

Planting of the cotton spacing test was delayed by excessive rains and yields were far below normal. The 6-inch spacing made a yield of 305 pounds compared to the usual 12-inch spacing with a yield of 276 pounds. Over a 10-year period the 6-inch spacing shows an advantage of 6% over the 12-inch spacing and is therefore recommended for general use.

Cotton Date of Planting Test: Cotton planted at 12- to 15-day intervals from April 18 to July 15, over a period of years, show that the earlier planting is best.

Cotton Duty of Water Test: In a year with excessive rainfall throughout, supplemental irrigation water did not increase yields of cotton. Normally yields are almost doubled by the proper use of irrigation water, according to period of years average.

Grain Sorghum Variety Test: Of 15 varieties of grain sorghums compared with corn, the 3 leading ones were Club, Ajax and Quadroon with yields of 30, 29 and 28 bushels, respectively. Corn produced an average of only 12 bushels.

Grain Sorghum Variety and Spacing Test: Dwarf Feterita, Hegari and Texas Blackhul Kafir were grown in 3, 6, 12, 18, and 24-inch spacings. In yield of grain these varieties rank in the order named. Dwarf Feterita does best in 3-inch spacing, Hegari in 6-inch spacing, and Kafir in 12-inch spacing.

Grain Sorghum Duty of Water Test: This year with unusual rainfall, supplemental irrigation water increased yields of grain sorghums only when applied in small quantities. The average over a period of years show grain sorghum yields to be almost doubled by the proper use of irrigation water.

Hegari Strains Test: Five strains of Hegari were planted on 3 dates, April 22, June 1, and July 15. These in order of yields from all dates of plantings were Early Hegari, Arizona, Woodward, Chillicothe and Lubbock. The first four named produced their best yields from the second date of planting while Lubbock produced best from the last date of planting. These yields were 33, 33, 26, 20, and 16 bushels, respectively.

Double Cropping with Early Grain Sorghums: Quadroon and Sooner Milo were planted on April 15 and June 15. Sooner Milo failed to produce a sucker crop from either date of planting. Although the last date is too late to expect a sucker crop of Quadroon, the main crop from this date exceeds both the main and sucker crop from the earlier date.

Width of Row Test with Grain Sorghums: Sooner Milo and Double Dwarf Milo produced best in 18-inch rows. Quadroon produced the same in 18-inch and 36-inch rows. Early Hegari produced best in the wider row of 36 inches. Brooks.

Small Grain Nursery

(In cooperation with the U. S. D. A.)

Wheat: Of 20 varieties of wheat included in this test, Kan. Hard Federation x Tenmarq 33-38-20 produced the highest yield of 18.3 bushels per acre. Other high yielding varieties were Denton, Red Chief, Tenmarq X Oro 70-38-44, and Hope X Med. 41-16-3-3 with yields of 17.8, 16.6, 16.1 and 15.7 bushels per acre respectively.

Barley: Of 12 varieties of barley the three highest yielding ones were Wintex, Finley and Harlan Hybrid 1-35-416 with yields of 26.4, 25.9 and 25.2 bushels per acre, respectively.

Oats: The best of 20 varieties and strains of oats were Ferguson, New Nortex, Nortex, Texas Red and Fultex, with yields of 48.4, 47.0 45.3, 42.9 and 40.8 bushels per acre respectively Brooks and Atkins.

Crop Rotation Studies

Alfalfa in the rotation increases yields of cotton noticeably and grain sorghum quite effectively. Two-year alfalfa is more effective than one-year alfalfa as indicated by its own production as well as production of crops that follow.

Castor Beans

Yields of approximately ½-ton per acre have been obtained from the better varieties of castor beans such as Kolp, U. S. D. A. 7, Flowering and Conner. Brooks.

Lamb Feeding Experiment

A total of 109 rambouillet lambs divided into 4 lots were fed for a period of 112 days on rations designed to compare (a) alfalfa hay vs. ground Quadroon stover, and (b) ground Quadroom heads vs. whole Quadroon heads. Lambs fed ground Quadroon stover were markedly inferior to those fed alfalfa hay. It did not pay to grind the Quadroon heads when they were fed with either alfalfa hay or ground Quadroon stover. Jones, (J. M.), Jones, (J. H.), and Brooks.

Fruit Adaptability Studies

Peaches: Frank, Early Rose, Dee Lee Cling, Halehaven and Hart Cling made the best yields this year. Halehaven continues to show up as the best of the new peaches from all standpoints, with Frank a close second.

Plums: Opata, Eagle, and the native plums T. S. 22674 and T. S. 27614 were the best in the orchard this year. No other varieties bore fruit.

Apricots: Superb has the highest average yield of the four varieties under test. Moorpark is of higher quality, better size and ranks second in yield.

Grapes and Berries: Black rot destroyed the grape crop. Yields of blackberries and dewberries were above normal. The best dewberry this year was Youngberry, with Austin Thornless second.

Cultural Tests with Peaches

At the end of the second year the test indicates that a summer cover of Sudan is more effective in improving the health and vigor of the trees than any other treatment. Yields were maintained but not improved by the Sudan cover crop in relation to other treatments. A winter cover of oats with 10 tons of barnyard manure seems to have increased yields somewhat.

Strawberry Soil Treatment

In order of yield the treatments rank as follows: 1) 2,000 pounds lime per acre; 2) 2,000 lbs. lime with 20 tons barnyard manue per A. 3) no treatment; 4) 4,000 lbs. lime per A. 5) 1,000 lbs. sulfur per A. 6) 600 lbs. sulfur per A. and 7) 40 tons barnward manure per A. The four-year summary of results shows the same relationship.

Vegetables

Because of the differences found in strains of the same varieties of vegetables the stock numbers and source of seed for the varieties performing best are given.

Cabbage: For 1941 midseason varieties of cabbage proved superior to early varieties. The best were All Head Select, Yellow Resistant, No. 308, Associated Seed Growers, Resistant Detroit, No. 87927, Ferry-Morse Seed Company, and Improved Globe, No. 90971, Associated Seed Growers.

Carrots: The best of 27 varieties and strains were Goldinheart and Tendersweet, W. Atlee Burpee Seed Company, and Hutchison, No. 75297, Ferry-Morse Seed Company.

Miscellaneous Vegetables: A small test of snap beans showed Idaho Refugee to be exceptionally good. Bliss Everbearing remains as one of the best English pea varieties. Iowana sweet corn seem to have possibilities in this area.

Cultural Tests With Vegetables

Corresponding best to the manuring tests are as follows: Sesbania green manure, 4,000 lbs. per A.: English peas; Barnyard manure, 10 tons per

A.: radishes, lettuce, carrots, cucumbers, Burpee's Stringless Green Pod beans, and cabbage; while Pinto beans did best on unmanured soil.

Straw as a Source of Organic Matter

Spinach was used as the indicator crop. With 16,000 pounds of straw and 1,000 lbs $(NH_4)_2SO_4$ per A. yield over no treatment was 27 percent greater. Straw alone decreased yields.

Growth of Vegetables in the Fall

It was found that a single weeks difference in planting date could make as much as 360 percent difference in the amount of growth a crop could make before being destroyed by cold weather. Further, root crops were more affected by changes in temperature than were leaf crops, and finally it was found that, in general, the growth rates of root crops were higher than for leaf crops.

Shade Trees and Ornamentals

A possible shade tree for the area may be *Ulmus crassifolia.* Trees set out in root-rot infected land in 1940 made excellent growth and showed no symptoms of root-rot during the year. Pickett.

Root Rot Studies

Crude Oil Treatment on Cotton Land: Crude oil at rates of 705, 1410, 4231, 7052, and 9873 gallons per acre applied to root-rot infested cotton land in 1938. Results of these treatments as compared to no-treatment check plats have been studied since that time. Although results have been quite variable, the fact that this year the no-treatment checks showed the greatest loss of plants due to root rot and the lowest yield of lint, indicates the oil may have some beneficial effect.

Sorghum as a Root-Rot Remover: A plot of ground is being planted to grass crops continuously to determine whether the root-rot fungus can be killed out by this method. Brooks.

Grape Resistance Studies: Champanel, Dog Ridge, Black Spanish and Mustang seem almost entirely resistant when grown on their own roots. When budded to other varieties Dog Ridge and *V. rupestris* appear to be best.

Apple Resistance Studies: Two trees of Ames 550 are believed to have died of root-rot in 1941. Up to the year 1941, inclusive, it is certain that four trees of this kind have died of the disease. All except two of the trees are known to be diseased. Pickett.

SUBSTATION NO. 19, WINTER HAVEN

Substation 19 is located in Dimmit County, between Carrizo Springs and Crystal City, in the center of a large area specializing in the production of vegetables under irrigation. The substation is located on fine sandy loam (mostly Webb and Crystal) with about 100 acres in cultivation. Irrigation water is supplied by pumping from underground sources.

The year 1941 was mostly cool and free from frosts. There were 345 frost-free days giving a long harvest season for fall crop of tomatoes, peppers and eggplant. Heavy rainfall, amounting to 27.5 inches, fell mostly in the spring and caused losses to the onion crop at harvest time. High humidity and cool temperatures also caused trouble with date ripening and delayed flowering of fruit crops in the spring. Ripening of citrus was delayed as much as a month in the fall. Weather was favorable for feed crops but unfavorable for cotton because of ideal conditions for boll weevil infestation.

The program of the substation consists of cultural, insect and disease studies with vegetable, fruit and other irrigated crops. Active breeding projects are carried in onions, spinach, canteloupes, tomatoes and strawberries.

Fruits

Adaptability: The following varieties bore satisfactory crops in 1941: San Jacinto apple; Toyahvale apricot; Luttichau, Smith, Babcock, Peento, PI 61302, Jewel and C. O. Smith peaches; Douglas and Pineapple pears; Tamopan persimmon; Methley, Munson, Santa Rosa, Jacob, Gonzales, and Excelsior plums.

Citrus Varieties: Some of the more promising varieties of Satsumas this year were Foley and Falsehybrid. These have a good dessert quality. They are larger trees than Owari and are later in coming into production. Owari is still the best shipping variety while Morita is the earliest maturing.

In average yields for the past six years, the best producing varieties of satsumas have been in order: Miyasaki, Foley, Owari, Horie, Yakushiji and Kawano.

The best yielding orange varieties have been Joppa, Louisiana Sweet and Hamlin. Texas Navels bore a good crop in 1941, averaging about 400 pounds per tree.

Heavy yields were secured from Meyer lemon this season. Three trees produced 2238 pounds of fruit during the fall and winter.

A good crop of Nagami kumquat was readily sold at holiday time.

Clementine tangerines are popular in the early market. Swatow is the heaviest yielder but not so attractive and ripens in January.

Citrus Rootstocks: Three years of seed yields were summarized for determining satisfactory stock varieties. The highest number of seeds *per fruit* were *Poncirus trifoliata*, 45.9; Duncan grapefruit, 40.6; Kansu orange, 31.4; sour orange, 27.5; Changsha tangerine, 23.2. In number of seeds *per pound of fruit* the highest average were from *P. trifoliata*, 656; Glen citrangedin, 146; Chinotti orange, 133; Changsha tangerine, 110; Calamondin, 105. The highest yields of seed per tree were, in order, trifoliate orange, Carrizo citrange, Changsha tangerine and citrumelo.

From a nursery standpoint the seedling return is also important. A test of 11 varieties gave the highest return of seedlings ready to bud in October from Carrizo citrange, *P. trifoliata*, sour orange and Swatow tangerine, in that order.

In orchard plantings Cunningham citrange shows definite lack of compatability with grapefruit varieties. The difference between young trees on Cunningham and Carrizo citrange stocks is striking.

In six-year averages Ikiriki satsuma has yielded 50% more on Savage citrange than on trifoliate stock. Kawano has yielded more than twice as much on 1537 citrange as on either Savage or Cunningham citrange. Silverhill is yielding much better on Cunningham citrange than on 5 other citrange varieties. There has been little difference in yield of Owari or Sueoka on various citrange varieties.

In the trial planted in 1938 Citrange stocks appear to be giving better results for satsumas than Calamondin, sour or trifoliate orange.

In the orange rootstock trials there has been little difference in Hamlin yields on three stocks. Joppa has yielded best on Rusk citrange and is greatly dwarfed on trifoliata orange. Texas Navel is doing best on Morton citrange.

Date Varieties: Only 5500 hours above 50°F. occurred by October 1 and ripening was late. High humidity and low sunshine from September 10 onward caused souring with nearly all varieties. Amir Hadj and Kustawy ripened on the trees during this period but curing was difficult. Early varieties ripening in August, such as Hayany, escaped the wet weather.

Grape Varieties: Heavy rains and lack of sufficient labor in the spring caused us to leave out our spray program with the result that most vinifera varieties were a total loss from black rot. Many American varieties ripened with very little or no disease injury. Notably among these were: Albania, Black Spanish, Catawba, Champanel, Concord, Ellen Scott, Hicks, Lomanto, Manito, Marguerite, Muench, Rommel, Salamander, and Valhallah. Twenty-five vinfera varieties were obtained for testing in 1942.

Grape Rootstock: Dog Ridge appears to be the most adaptable stock of those tried. Propagating material of 11 stock varieties not previously tested at Winter Haven was secured from the U. S. Department of Agriculture, Grape Laboratory, Fresno, California.

Strawberry Variety and Breeding: Heavy rains and bud-nematode damage caused a very disappointing strawberry season. In fact, the leaf-bud nematode has nearly wrecked our breeding program. Conscientious roguing failed to check it so an attempt is being made to establish a clean planting in a different part of the farm.

Some of the outstanding varieties for commercial purposes are Alamo, Ranger, and selections T28, T46, T72, T175, and T458. These all withstood adverse wet weather better than Missionary or Klondike and showed good heat resistance as well. Mortensen.

Ornamentals

Weather was unusually favorable for ornamentals this year. Some of the outstanding ornamentals during the year were: *Callistemon citrinus*, oleanders, *Tecoma stans*, *Antigonon leptopus*, *Chilopsis linearis*, *Ipomoea cairica*, Crape myrtle, sotol, *Pyracantha rogersiana*, *Sageretia theegans*, chrysanthemums, and *Carissa grandiflora*. Mortensen.

Field Crops

Corn Varieties: In a planting of 30 varieties and hybrids Mexican June outyielded all varieties with 45.9 bushels per acre. Other open pollinated varieties were Red June, 35.5; Denco Yellow Dent, 34.7; Golden June, 33.4; Surcropper, 32.7.

Of 15 hybrids planted the five highest were: four Texas station hybrids in order and Iowealth 30 ranking fifth. These five were all 40 bushels or more per acre. All the four Texas hybrids included the single cross, 127C x 132A.

Cotton Varieties: The planting at El Indio in Maverick county was harvested in August. Although dusted with calcium arsenate for boll weevil control most of the second picking was lost through a rain in early August causing the crop to shed. The two outstanding varieties were easily Stoneville 2B and Washington (Delfos 719). Since these varieties were also best in 1940, it would seem that one of these varieties might well be suitable for the El Indio section.

Sorghum Varieties: A sorghum variety test at Quemado gave very unsatisfactory results. Apparently they were in a drought area and sorghum midges greatly reduced the grain yield.

Soybean. Twenty-eight varieties of soybeans were planted at Quemado in Maverick county on a sandy loam soil. A disease, tentatively identified as *Rhizopus* sp., caused a loss of all seed maturing before August 15. Best seed production was indicated on Macoupin, Pocahontas, and Wood's Yellow. For hay production, Palmetto, Hayseed, Clemson and White Beloxi looked promising because of fine stems, leafiness and tonnage.

A variety planting made in the fall at Winter Haven apparently had too short a light period and failed to grow properly.

Crotalaria and Cowpeas were planted at Quemado with the soybean variety trial. Iron and Brabham gave only a fair growth and produced very little seed.

Crotalaria juncea grew to 8 feet in height and had 16 tons green weight per acre on August 28. No seed was set.

Peanut Fertilizers: A peanut fertilizer trial was planted at Dilley, Texas, in Frio county. No significant differences were secured between 9 different treatments. It is possible that summer drought affected the differences or that the soil lacked sufficient uniformity.

Sweet Clovers: Twenty-four selections of annual sweet clovers were planted in the winter of 1940-41 for observation. Several of these selections had fine stems and were promising for forage. Temple Hubam had especially good seed yields.

Flax Varieties: A large planting of flax varieties and selections was made and some notes were made. Seed yields were obviously high but harvesting was impossible because of lodging and tangling from rains and wind. Mortensen.

Vegetables—Variety Descriptions

(In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture)

Because field data have in general been collected more rapidly than it could be analyzed and worked up in connection with the work done in other sections, emphasis in 1941 was given to the summarizing of results obtained in the past.

Adaptability Studies: Weather conditions in the spring were none too favorable for beans, the temperature being below normal for much of the time, and precipitation being above normal. Among the high yielding varieties of the green podded dwarf snap beans were Stringless Black Valentine, Tender Pod, and Bountiful. None of the wax varieties even approached the moderately yielding green pod varieties in productivity. This is in line with previous observations at the Station. Pencil Pod Black Wax and Brittle Wax were among the most satisfactory of the Wax sorts. Blue Lake, Ideal Market and Kentucky Wonder all did well among the pole beans. No variety of lima bean excelled Henderson Bush in adaptability to warrant its recommendation ahead of that variety. Among the soybeans Bansei, Emperor, Higan, Toku, Willomi, and Imperial were fairly productive, but the pods of all tended to be small, hard to pick, and hard to shell.

Among the sweet corn varieties Ioana and Ioglen again appeared well adapted with the former the better of the two. Several Yellow Sweet corn hybrids developed at the main station and included in these trials excelled Ioana, but these have not yet been named and seed is not yet available for distribution.

The edible cowpea trial did not change the varietal situation with this crop. Cream Crowder and Purple Hull still appeared to be among the desirable varieties. Most of the Blackeye strains were early, and Large Blackeye was especially productive.

In the tests of New York or "Iceberg" type lettuce planted at several successive plantings in the Fall of 1940, but mostly harvested in the early months of 1941, Imperial strains 44, 152 and 847 were the most promising. The value of the various strains varied somewhat with the time of planting. No. 44 will probably withstand more heat than the others.

In the tomato variety trials there was no new variety to excel Stokesdale. Pan America the new variety developed by the United States Department of Agriculture was too late in both the spring and fall trials to warrant much promise for this section. Of the varieties in which commercial growers show especial interest Stokesdale yielded at the rate of 19,794 pounds of marketable fruit per acre, Grothens Globe 11,078 pounds, Certified Crown Picked Rutgers 10,386 pounds, Certified Rutgers 9,787 pounds and Master Marglobe 6,514 pounds. Stokesdale gained much of the advantage by yielding well at the first harvest. The differences in yield between Grothens Globe, Certified Crown Picked Rutgers and Certified Rutgers were not statistically significant.

Fertilizing Onions in Seedbed: Onions receiving fertilizer in the seedbed yielded approximately the same as those left unfertilized. On a naturally fertile soil, fertilizer applied to the seedbed probably does not pay; on a poor piece of ground it very likely will.

Camparison of Dry Sets with Green Plants: Through the cooperation of the Illinois Experiment Station some dry sets of Yellow Bermuda onions were grown in the North, and then green sets or plants of the same lot of seed were grown at Winter Haven. The dry sets were planted at three different times. The results were complicated by the high percentages of bolters in all treatments, although there were definitely fewer with each successive planting. All things considered the results of this experiment, in this and past years, seem to favor the plants. The matter is by no means settled, and will be investigated further in future tests.

Time of Planting Onions: Two varieties were involved in this test, namely Yellow Bermuda and Early Grano (also called Babosa). There were two times of planting: the so-called normal time of around September 20, and one about two weeks earlier than this. With both Yellow Bermuda and Early Grano there was a greater total yield from the first planting, but Yellow Bermuda had the larger marketable yield in the second planting, and Early Grano the larger marketable yield in the first. The yields of U. S. No. 1 onions were: Yellow Bermuda, first planting, 64 bushels; second planting 117 bushels; Early Grano, first planting, 334 bushels; second planting 250 bushels. Yellow Bermuda failed to have a high marketable yield when planted early because 64.2 percent of the bulbs by weight were bolters. There were no bolters at all in either planting of Early Grano. These results are in line with those reported a year ago and indicate that Early Grano can be safely planted in early September, but Yellow Bermuda cannot.

Time of Harvesting Onions: Plats of Yellow Bermuda and Early Grano onions were harvested at three different times each from two or three

weeks apart. The first was at the time when the tops were beginning to fall over, the second when 40 to 50 percent of them were down, and the last when 80 to 90 percent or more were over. Yields in bushels of U. S. No. 1 onions per acre for Yellow Bermuda at the three successive harvestings were: 38, 47 and 66. For Early Grano the corresponding figures were: 293, 315 and 378. The low marketable yields of Yellow Bermuda were due to high percentages of seedstems (bolters). The results are in line with those of last year that early harvesting is probably not profitable, unless the price received is very high.

Handling Tomatoes in the Seedbed: In the spring planting tomato plants of the Stokesdale variety spaced 3x3 inches in the seedbed, later yielded in the field at the rate of 2381 pounds of marketable fruit per acre during the first four pickings, as compared with only 314 pounds from plants which until their removal to the field had been left crowded 50 plants per foot, with rows 4 inches apart. Plants thinned to 12 plants per foot in the seedbed, later produced at the rate of 701 pounds per acre of marketable fruit in the same four pickings.

Fertilizer Test with Watermelons: For the second year in succession four fertilizer treatments were tried with watermelons on a farm near Dilley, Texas. The results for both years have been consistent in indicating that the 13½-34-0 fertilizer at the rate of 100 pounds per acre is much more preferable to the 6-10-7 mixture.

Tomato Breeding: A third generation of crosses between Summerset and Bison were grown during the summer, and contained much promising material from which a number of selections were made. Fruits weighing around 150 grams a piece were harvested from these selections during the heat of the summer.

Onion Breeding (In cooperation with the Bureau of Plant Industry, U. S. Department of Agriculture). Greater quantities of seed, as well as seeds from a greater number of plants were collected in the spring of 1941, than had been collected in several seasons. As a result of the several hundreds of crosses and selections grown in the new cooperative work with the U. S. Department of Agriculture, a number of promising selections were made, representing both Yellow Bermuda and Early Grano types. A still larger collection was planted in the fall of 1941 for selection work in the spring of 1942. A definite effort is being made towards obtaining strains of Crystal Wax and Yellow Bermuda which will not bolt. Breeding for thrip resistance is also part of the project.

Hawthorn.

Plant Diseases

Breeding Spinach for Disease Resistance: White Rust, caused by the fungus *Albugo occidentalis*, is the most severe spinach disease. The control of this disease by fungicides is difficult and so far appears uneconomical, therefore most efforts have been placed on breeding for disease resistance. Many hundreds of acres of diseased spinach were combed in order

to find a few plants that did not have the disease but such disease-free plants were not found. About 400 plants were selected which showed only slight infection while hundreds of thousands of other plants were heavily infected, or were killed by the fungus. The selected plants were transplanted to a special breeding plot and from them, some seed was obtained for further breeding work.

The spread of white rust within the field, and from one field to the next, has been confirmed as due to irrigation flood water as the principal carrier of the fungus spores. So long as irrigation is practiced by flooding and submerging almost the entire crop with water, the spread of the disease will continue.

Breeding Onions for Disease Resistance: The work on breeding onions for resistance to the pink-root disease is continuing. It has been definitely established that the Early Grano or Babosa variety of onion is much more susceptible to the pink-root disease than the Bermuda varieties.

Breeding Cantaloupes for Resistance to Downy Mildew: The cantaloupe breeding work for resistance to downy mildew, aphids, and other troubles has been carried another year with promising results. The season was very favorable for this work. Some of the station-bred strains are now in the F_4, F_5, and F_6 generations, and have shown shipping qualities combined with resistance to different trouble in various degrees.

Eggplant "yellows": The nature of this virus disease has been studied. Although its insect carrier is still unknown, the disease has been transmitted to cucumber by rubbing with infectious juice, producing leaf mottling. It has been induced on eggplant by rubbing with juice obtained from field-grown cantaloupe plants that showed a type of mosaic symptoms. Efforts to transmit the disease from eggplants to tomatoes, peppers, potato, and other plants have thus far failed. The infectivity of the virus seems to be seriously affected by drying.

Chemical Deposits on Foliage of Citrus and Other Plants, and their Possible Relations to Chlorosis and Yield: Dry chemical deposits, often in large amounts, were found on the surface of leaves of citrus, cantaloupes, crape myrtle, tamarisk, strawberries, and other plants in the spring and fall of 1941. By the same time some of the plants particularly the Satsuma orange trees suffered from an abnormal yellowing of the leaves and dropping of the fruit. In the case of the cantaloupes a connection appeared between the guttation water exuded from the water pores (hydathodes) along the edge of the leaf, on one hand, and the formation of the dry chemical deposit and yellowing of the leaf margin (chlorosis) on the other. A chemical analysis of the dry deposits collected from citrus leaves showed the soluble part of these deposits contained chlorides, sulphates, calcium, and probably other salts. The insoluble part contained large amounts of calcium and magnesium carbonte, silica and iron and alumina oxide. About 20 percent of the insoluable deposit was

organic matter. Guttation water collected from cantaloupe leaves supported abundant bacterial growth which indicates that it contained essential mineral salts and carbohydrates, probably sugars. The pH (or the hydrogen-ion concentration) of the guttation water was 6.8; that of the chemical deposit 7.7.

Sulphur in relation to chlorosis in cowpeas and root nodule production: Yellowing of the foliage of various plants grown in soils high in lime is common in the Winter Garden. Studies on the correction of this condition by addition of sulphur have been continued. In greenhouse experiments, the results have shown that 2 years after a heavy application of sulphur to heavy river soil the cowpeas, (used as a test crop) continued to grow normally, while similar plants grown in the same soil without the sulphur, invariably showed the yellow, chlorotic condition. In the meantime the acidity of the soil has undergone little change since the application of the sulphur.

A striking effect from the application of sulphur to such soils is the increase in number and size of the nitrogen-fixing root nodules. The cowpeas grown in the heavily sulphur-treated soil produced from 2 to 4 times more nodule tissue than those grown in soil to which no sulphur was added. Ivanoff.

Insects

Onion thrips (Thrips tabaci): In general thrips damage to onions was relatively slight in 1941 inasmuch as destruction numbers did not appear until late in the season. Experiments were conducted in which naphthalene and nicotine-sulphur dusts were applied as control measures. The thrips population was held in check somewhat by both materials but the magnitude of the effect was insufficient to warrant the use of either material on a commercial scale.

Tomato fruit worm on beans. (Heliothis armigera): This insect was controlled satisfactorily by fluosilicate dusts. Analyses of residue on beans which were dusted showed that where 10 pounds of synthetic cryolite per acre were used and the beans washed the fluorine residue was below the legal tolerance level. When 20 pounds of the cryolite were applied injurious residues were present on the beans.

Wingless May Beetles: Two species did extensive damage to spinach and onion plants in local areas. On the basis of observations it appears the most practical means of control for these pests is to surround the infested area with a mold board plow furrow, having the land side away from the line of migration, and applying a band of poison bran each day near the furrow.

Vegetable weevil. (Listroderes obliquus): This insect was found at Uvalde on April 22 and one month later at La Pryor in the Winter Garden area. These are the first reports of this injurious pest in southwest Texas. S. E. Jones.

SUBSTATION NO. 20, STEPHENVILLE

Substaion No. 20, serving the West Cross Timbers Region, is two miles northeast of Stephenville, Erath County, The 619 acres of land acquired in January 1941 consist largely of Windthorst and Stephenville soil series. The year has been spent in constructing terraces, eradicating Johnson grass, laying out field plats, and in other activities necessary for getting the station in actual operation. Langley and Denman.

Land Use Adjustment in West Cross Timbers

The object of this project is to develop information essential to the better use of land in the area. Cooperative relations with 104 representative farmers chiefly in Erath, Comanche, Brown, and Eastland counties have been established. Inventories of these farms have been made and a system for keeping accurate records of farm operations has been inaugurated. Langley, Bonnen, and Czarowitz.

COOPERATION

Memoranda of agreement providing for cooperative research have been entered into or continued during the year with the following bureaus of the United States Department of Agriculture:

Bureau of Agricultural Economics:

1. A study of agricultural adjustment in Texas;
2. Cotton fiber and spinning research (also with the Bureau of Plant Industry and the Texas Engineering Experiment Station);
3. A study to determine the economic and social effects on farms resulting from the operation of a definitely planned program of soil conservation;
4. An estimate of the farm population and farm population movements;
5. The accuracy of small samples for wool shrinkage and grading determinations;
6. A study of Texas farm leasing arrangements in relation to the conservation of agricultural resources.

Bureau of Animal Industry:

1. Investigations of the loco problem in Western Texas;
2. Beef cattle husbandry investigations relating to the fattening of steers at different levels of feeding (also with Bureau of Plant Industry);
3. Beef cattle feeding investigations to determine the quantity of carotene required for growing and fattening steers;
4. Beef cattle feeding investigations relating to mineral-deficiency studies in range beef-cattle production;
5. A study of the inheritance of skin folds in Rambouillet sheep;
6. Improvements of sheep for western ranges through the application of breeding methods;

7. The mechanism of infection, resistance, and immunity in the contagious, infectious, and parasitic diseases of domestic animals and poultry.

Bureau of Agricultural Chemistry and Engineering:

1. Research on citrus products and on methods of preservation of fruits and vegetables;
2. Research on utilization of farm products (Southern Regional Laboratory, Now Orleans).

Bureau of Biological Survey:

1. Regional and state wildlife research (also with the Texas Extension Service and the State Game, Fish, and Oyster Commission).

Bureau of Plant Industry:

1. The production, improvement, and diseases of cereal crops, particularly corn, wheat, oats, sorghum, and rice;
2. The production, improvement, and diseases of cotton;
3. Field testing of Satsuma orange varieties and hybrids and stock plants for them;
4. Study and description of American varieties of vegetable crop plants for the purpose of establishing variety type standards;
5. Investigations in the development of forage and soil improving crops adapted to Northern Texas and contiguous areas (at Substation No. 12, Chillicothe);
6. Experiments in the testing of dates at Substation 15, Weslaco, and in Southwest Texas;
7. Investigations on insecticide and tannin plants and their possibilities as crops in the United States;
8. Vegetable breeding investigations in the Southeastern States and at the U. S. Regional Vegetable Breeding Laboratory;
9. Investigations on introduction, breeding, and testing varieties and seedlings of sweet potatoes;
10. Investigations on the occurrence of boron injury to citrus and other crop plants in the Lower Rio Grande Valley.
11. Soil surveys in Texas.

Bureau of Entomology and Plant Quarantine:

1. Investigations of insects and parasites affecting livestock;
2. Cotton insect investigations, including biology and control of pink bollworm and cotton bollworm;
3. Investigation on the resistance of honey bees to American foulbrood.

Soil Conservation Service:

1. Soil and water conservation research in the State of Texas, at Temple, Tyler, Spur, Amarillo, and Brushy Creek Watershed.

LETTER OF TRANSMITTAL

September 15, 1941.

Director A. B. Conner,
Texas Agricultural Experiment Station.

Dear Director Conner:

There is submitted herewith the annual financial report of the Texas Agicultural Experiment Station for the fiscal year ended August 31, 1941.

In accordance with Subsection 1, Chapter 8, Special Laws Forty-sixth Legislature—Regular Session, all exhibits and schedules contained in this report have been prepared as nearly as practicable in conformity with the suggestions made by the National Committee on Standard Reports for Institutions of Higher Education.

Respectfully submitted,
M. P. HOLLEMAN, Chief Clerk.

Approved:
W. H. HOLZMANN,
Comptroller.

EXHIBIT A

Texas Agricultural Experiment Station Balance Sheet

As of August 31, 1941

ASSETS

I. CURRENT FUNDS				
A. RESEARCH AND GENERAL				
Cash			$ 132,533.40	
Balance in State Appropriations (Schedule B-1a			948.97	
Feed Control Tags				
Inventory		$ 1,866.01		
C. O. D. Shipments		320.09	2,186.10	
Supplies and Crops Inventories				
Supplies		$ 146,405.45		
Crops		18,827.76	165,233.21	
Total Research and General				$ 300,901.68
B. AUXILIARY ENTERPRISES AND ACTIVITIES				None
C. CURRENT RESTRICTED FUNDS				
Cash			$ 1,879.06	
Total Current Restricted Funds				$ 1,879.06
TOTAL CURRENT FUNDS ASSETS				$ 302,780.74
II. LOAN FUNDS				None
III. ENDOWMENT FUND				None
IV. PLANT FUNDS				
A. UNEXPENDED			None	
B. INVESTED IN PLANT				
Physical Plant (Exhibit E)		$1,432,543.16		
Total Invested in Plant			$1,432,543.16	
TOTAL PLANT FUNDS ASSETS				$1,432,543.16
V. AGENCY FUNDS				None
GRAND TOTAL ASSETS				$1,735,323.90

EXHIBIT A

Texas Agricultural Experiment Station Balance Sheet

As of August 31, 1941

LIABILITIES

I. CURRENT FUNDS			
A. RESEARCH AND GENERAL			
Accounts Payable			
Main College—Feed Control Service			
Tag Inventory and C. O. D.'s		$ 2,186.10	
Reserve for Supplies			
and Crops Inventories		165,233.21	
Revolving Funds Balances (Sch. B-4)		11,317.71	
Current Balances (Exh. B)			
Appropriated for Special Purposes			
Federal—Hatch Fund Balance	$ 1,468.92		
Federal—Adams Fund Balance	1,295.02		
Federal—Purnell Fund Balance	5,549.13		
Federal—Bankhead-Jones Fund Balance	12,357.28		
State Apprns. Bals.—Main Station	782.73		
State Apprns. Bals.—Substations	13.33		
Sales Funds Bals.—Main Station	32,919.88		
Sales Funds Bals.—Substations	67,625.46		
Total Appro. for Special Purposes		122,011.75	
Reserve for Contracts and Orders		152.91	
Total Research and General			$ 300,901.68
B. AUXILIARY ENTERPRISES AND ACTIVITIES			None
C. CURRENT RESTRICTED FUNDS			
Fund Balances			
(Per Exhibit B and Schedule B-3)		$ 1,879.06	
Total Current Restricted Funds			$ 1,879.06
TOTAL CURRENT FUNDS LIABILITIES			$ 302,780.74
II. LOAN FUNDS			None
III. ENDOWMENT FUND			None
IV. PLANT FUNDS			
A. UNEXPENDED		None	
B. INVESTED IN PLANT (Exhibit E)			
Net Investment in Plant	$1,432,543.16		
Total Invested in Plant		$1,432,543.16	
TOTAL PLANT FUNDS LIABILITIES			$1,432,543.16
V. AGENCY FUNDS			None
GRAND TOTAL LIABILITIES			$1,735,323.90

EXHIBIT B

Summary Statement of Current Funds

For the Year Ended August 31, 1941

BALANCES, September 1, 1940			
Current Funds—Research and General			
Reserve for Outstanding Orders		$ 8,812.74	
Appropriated for Special Purposes			
Federal—Hatch Fund	$ 1,390.28		
Federal—Adams Fund	1,139.18		
Federal—Purnell Fund	5,846.18		
Federal—Bankhead-Jones Fund	14,271.12		
State Apprns.—Main Station	245.00		
State Apprns.—Substations	4,053.06		
Sales Funds—Main Station	28,660.55		
Sales Funds—Substations	47,905.84	103,511.21	$ 112,323.95
Current Restricted Funds			
Texas Gulf Sulphur Fund		$ 1,730.38	
Freeport Sulphur Fund		487.04	
Cotton and Fruit Insect Survey Fund		1,360.92	
Cuprocide Fund		269.31	3,847.65
TOTAL BALANCES, September 1, 1940			$ 116,171.60
ADD:			
Current Research and General Income (Sch. B-1)		$ 784,806.47	
DEDUCT:			
Current Research and General Expenditures (Schedule B-2)	$ 770,816.28		
Unused 1939-40 Leg. Appro. Reverted (Schedule B-1a)	6,118.07	776,934.35	
Net Additions			$ 7,872.12
BALANCES, August 31, 1941			$ 124,043.72
Consisting of:			
Current Funds—Research and General (To Exhibit A, Section I-A)			
Reserve for Outstanding Orders		$ 152.91	
Appropriated for Special Purposes			
Federal—Hatch Fund	$ 1,468.92		
Federal—Adams Fund	1,295.02		
Federal—Purnell Fund	5,549.13		
Federal—Bankhead-Jones Fund	12,357.28		
State Apprns.—Main Station	782.73		
State Apprns.—Substations	13.33		
Sales Funds—Main Station	32,919.88		
Sales Funds—Substations	67,625.46	122,011.75	$ 122,164.66
Current Restricted Funds (Sch. B-3)			
Texas Gulf Sulphur Fund		$ 524.64	
Freeport Sulphur Fund		393.95	
Cotton and Fruit Insect Survey Fund		303.53	
Cuprocide Fund		177.57	
Dow Chemical Co. Fund		66.12	
Niagara Fellowship Fund		250.00	
American Potash Fund		163.25	1,879.06
Total, as shown above			$ 124,043.72

SCHEDULE B-1

Statement of Current Income

For the Year Ended August 31, 1941

	Total	Current General Funds	Current Restricted Funds
I. RESEARCH AND GENERAL			
1. Student Fees (None)			
2. Public Appropriations			
a. Federal			
Hatch Act (1887)	$ 15,000.00	$ 15,000.00	
Adams Act (1906)	15,000.00	15,000.00	
Purnell Act (1925)	60,000.00	60,000.00	
Bankhead-Jones Act (1935)	149,364.76	149,364.76	
Total Federal	$ 239,364.76	$ 239,364.76	
b. State Legislative Appropriations (Schedule B-1a and B-1b)	377,483.00	377,483.00	
Total Public Appropriations	$ 616,847.76	$ 616,847.76	
3. Endowment Income (None)			
4. Gifts and Grants (Schedule B-3)	4,049.25		$ 4,049.25
5. Sales and Services (Schedule B-1c)	163,504.05	163,504.05	
6. Other Sources			
Interest on Bank Balances	405.41	405.41	
Total Research and General (to Exh. B)	$ 784,806.47	$ 780,757.22	$ 4,049.25

SCHEDULE B-1a

Summary of State Legislative Appropriations

For the Year Ended August 31, 1941

	Total	Main Station	Sub-Stations
Balances, September 1, 1940, from Appropriations for Previous Year	$ 13,110.80	$ 271.54	$ 12,839.26
Add Appropriations for Current Year (Schedule B-1b)	377,483.00	169,543.00	207,940.00
Total Balances from Previous Year Plus Appropriations for Current Year	$ 390,593.80	$ 169,814.54	$ 220,779.26
Less Expenditures (Schedule B-2)	383,526.76	168,786.81	214,739.95
Unexpended Balances	$ 7,067.04	$ 1,027.73	$ 6,039.31
Less Reversions to State Treasury from Previous Year Balances (to Exhibit B)	6,118.07	245.00	5,873.07
Balance August 31, 1941 (to Exh. A)	$ 948.97	$ 782.73	$ 166.24

SCHEDULE B-1b

Statement of Current Income from State Legislative Appropriations (General Revenue)

For the Year Ended August 31, 1941

(Pages 329 to 339 Special Laws, Forty-sixth Leg.—Regular Session)

State Appro. Number			
MAIN STATION:			
B-309	—Salaries	$ 49,597.00	
	Less amount accounted for under Substations	6,435.00	$ 43,162.00
B-310	—Administrative	$ 14,150.00	
	Less amount transferred to State Auditor's Dept.	225.00	13,925.00
B-309 & 312	—Veterinary Science		2,600.00
B-309 & 311	—Horticulture		3,450.00
B-309 & 313 & 337	—Range Animal Husbandry		7,580.00*
B-309 & 314-16	—Entomology (Including Foul Brood)		11,126.00
B-309 & 317	—Apriculture		6,355.00
B-309 & 318	—Agronomy		3,280.00
B-309 & 319	—Main Station Farm		4,610.00
B-309 & 320-24	—Plant Pathology		8,980.00
B-309 & 325	—Soil Survey		8,330.00
B-309 & 326	—Farm and Ranch Economics		5,170.00
B-327	—Publications		5,000.00
B-328	—Botany		250.00
B-309 & 329-31	—Cotton Root Rot Investigations	$ 20,475.00	
	Less amount accounted for under Substations	9,825.00	10,650.00
B-309 & 332	—Cotton Insect Investigations		13,435.00
B-309 & 333	—Loco Weed Research		6,040.00
B-334	—Sweet Potato Investigations		3,500.00
B-335	—Fruit Investigations		8,700.00
B-336	—Brazos River Alluvial Soils		3,400.00
Total Main Station			$ 169,543.00
SUBSTATIONS:			
B-309	—Salaries (See Main Station)		$ 6,435.00
B-309 & 329-31	—Cotton Root Rot Investigations (See Main Station)		9,825.00
B-338 & 339-40	—No. 1—Beeville		10,660.00
B-338 & 341-42	—No. 2—Tyler		14,965.00
B-338 & 343-47	—No. 3—Angleton and Truck Crop Insect Inv.		21,260.00
B-338 & 348-49	—No. 4—Beaumont		9,310.00
B-338 & 350	—No. 5—Temple		8,710.00
B-338 & 351-52	—No. 6—Denton		6,810.00
B-338 & 353-55	—No. 7—Spur		8,610.00
B-338 & 356-57	—No. 8—Lubbock		8,660.00
B-338 & 358	—No. 9—Balmorhea		4,310.00
B-338 & 359	—No. 10.—College Station (Feeding and Breeding)		5,770.00
B-338 & 359	—Division of Dairy Husbandry		2,450.00
B-338 & 359	—Division of Swine Husbandry		4,250.00
B-338 & 359	—Division of Poultry Husbandry		3,750.00
B-338 & 360-65	—No. 11—Nacogdoches		18,860.00
B-338 & 366-67	—No. 12—Chillicothe		5,210.00
B-338 & 368	—No. 14—Sonora		13,955.00
B-338 & 369-70	—No. 15—Weslaco (Lower Rio Grande)		14,415.00
B-338 & 371	—No.16—Iowa Park (Wichita Valley)		8,160.00
B-338 & 372-74	—No. 19—Winter Haven		12,625.00
B-338 & 375-76	—No. 20—Stephenville		8,940.00
Total Substations			$ 207,940.00
Total State Legislative Appropriations			$ 377,483.00

*$1,200.00 of this amount, Account B-337, appropriated by the 47th Leg.; R. S.

SCHEDULE B-1c

Statement of Current Income from Sales and Services

For the Year Ended August 31, 1941

MAIN STATION:	
Administrative	$ 1,757.58
Vetrinary Science	1,671.26
Horticulture	987.70
Range Animal Husbandry	1,650.52
Entomology	477.29
Apiculture	92.50
Main Station Farm	4,138.13
Plant Pathology	135.59
Loco Weed Research	543.04
Chemical Analysis	18,602.44
Photographic Laboratory	4,933.85
Big Spring Cattle Feeding	4,183.99
Rural Home Research	100.03
Agricultural Engineering	30.23
Total Main Station	$ 39,313.15
SUBSTATIONS:	
No. 1—Beeville	$ 5,627.05
No. 2—Tyler	2,542.65
East Texas Soil Erosion	1,780.94
No. 3—Angleton	1,788.23
Truck Crop Insect Investigations	163.10
No. 4—Beaumont	536.23
No. 5—Temple	901.48
Temple Soil Erosion	10,503.10
No. 6—Denton	7,344.56
No. 7—Spur	7,265.26
No. 8—Lubbock	3,363.20
No. 9—Balmorhea	4,262.16
No. 10—College Station (Feeding and Breeding)	1,069.22
Division of Dairy Husbandry	21,228.57
Division of Swine Husbandry	8,041.73
Division of Poultry Husbandry	6,602.74
No. 11—Nacogdoches	3,649.29
No. 12—Chillicothe	3,372.29
No. 14—Sonora	15,512.34
No. 15—Weslaco (Lower Rio Grande)	5,988.60
No. 16—Iowa Park (Wichita Valley)	3,141.73
No. 19—Winter Haven	4,606.08
Amarillo Soil Conservation	4,900.35
Total Substations	$ 124,190.90
Total Sales and Services	$ 163,504.05

SCHEDULE B-2

Statement of Current Expenditures

For the Year Ended August 31, 1941

	FUND DISTRIBUTION					Grand Total	OBJECT CLASSIFICATION			
	CURRENT GENERAL FUNDS									
	Federal Funds	State Apprns.	Sales Funds	Total General	Current Restricted Funds		Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements
RESEARCH AND GENERAL										
Man Station:										
Administrative	$ 12,801.36	$ 28,331.85	$ 436.85	$ 41,570.04		$ 41,570.04	$ 27,113.60	$ 4,183.86	$ 10,272.58	
Veterinary Science	10,374.70	5,815.00	897.20	17,086.90	$ 14.54	17,101.44	13,351.15	3,041.63	708.66	
Horticulture	8,753.46	18,825.00	739.53	28,317.99	277.70	28,595.69	21,849.10	3,370.14	2,926.20	$ 450.25
Range Animal Husbandry	25,803.96	12,705.00	5,772.51	44,281.47		44,281.47	30,165.72	4,659.04	7,180.63	2,276.08
Entomology	9,444.17	27,235.20	703.05	37,382.42	2,795.95	40,178.37	32,848.50	5,455.82	1,808.47	65.58
Apiculture		6,355.00	34.79	6,389.79		6,389.79	5,443.99	352.21	593.59	
Agronomy	37,593.54	13,720.00	7.83	51,321.37	336.75	51,658.12	45,925.11	4,931.42	721.56	80.03
Main Station Farm		8,010.00	3,504.39	11,514.39		11,514.39	7,016.58	3,261.58	753.20	483.03
Plant Pathology	10,793.65	14,500.00	400.87	25,694.52	2,092.90	27,787.42	21,914.33	3,537.14	2,057.37	278.58
Soil Survey	312.51	8,136.80	340.06	8,789.37		8,789.37	7,521.27	737.05	531.05	
Farm and Ranch Economics	33,264.55	6,935.00		40,199.55		40,199.55	35,429.78	4,567.36	202.41	
Publications		7,080.00		7,080.00		7,080.00	2,080.00	5,000.00		
Botany	1,320.00	1,450.00		2,770.00		2,770.00	2,520.00	221.06	28.94	
Loco Weed Research		3,095.00	182.16	3,277.16		3,277.16	2,666.62	306.62	303.92	
Chemistry	21,475.12	5,242.92	18,156.68	44,874.72		44,874.72	39,989.24	4,417.71	467.77	
Photographic Laboratory		1,350.00	4,102.61	5,452.61		5,452.61	3,357.50	1,764.29	330.82	
Rural Home Research	19,791.24		167.26	19,958.50		19,958.50	16,792.59	1,815.37	1,350.54	
Agricultural Engineering	7,841.35		13.50	7,854.85		7,854.85	7,166.70	648.52	39.63	
Total Main Station	$ 199,509.61	$ 168,786.81	$ 35,459.23	$ 403,815.65	$ 5,517.84	$ 409,333.49	$ 323,151.78	$ 52,270.82	$ 30,277.34	$ 3,633.55

SUBSTATIONS:										
No. 1—Beeville		$ 10,660.00	$ 4,107.78	$ 14,767.78		$ 14,767.78	$ 9,150.75	$ 5,277.01	$ 25.90	$ 314.12
No. 2—Tyler	$ 945.00	14,813.78	2,983.22	18,742.00		18,742.00	14,837.14	3,106.73	681.23	116.90
No. 3—Angleton	9,860.78	16,894.64	1,281.37	28,036.79		28,036.79	18,345.10	4,478.47	2,341.22	2,872.00
Truck Crop Insect Investigations		4,400.00	136.29	4,536.29		4,536.29	3,945.00	504.93	86.36	
No. 4—Beaumont		9,353.34	795.01	10,148.35		10,148.35	7,716.89	1,756.10	675.36	
No. 5—Temple		16,885.00	5,646.72	22,531.72		22,531.72	13,333.13	5,676.83	2,876.31	645.45
No. 6—Denton	225.00	6,810.00	5,374.93	12,409.93		12,409.93	6,445.04	3,735.60	1,862.79	366.50
No. 7—Spur	1,487.50	8,610.00	10,046.37	20,143.87		20,143.87	9,203.58	5,536.10	3,804.91	* 1,599.28
No. 8—Lubbock		8,660.00	2,924.50	11,584.50		11,584.50	8,339.05	1,899.75	667.40	678.30
No. 9—Balmorhea		4,310.00	2,085.69	6,395.69		6,395.69	5,297.93	922.01	175.75	
No. 10—College Station (Feeding and Breeding)		5,770.00	1,348.50	7,118.50		7,118.50	4,577.95	1,766.30	544.53	229.72
Division of Dairy Husbandry	7,493.45	3,350.00	16,711.24	27,554.69		27,554.69	12,713.88	13,141.41	1,691.40	8.00
Division of Swine Husbandry	7,819.07	6,895.00	7,217.54	21,931.61		21,931.61	11,442.38	7,949.08	2,449.35	90.80
Division of Poultry Husbandry	5,331.69	6,626.67	6,754.16	18,711.92	$ 500.00	19,211.92	11,761.94	6,984.83	334.42	130.73
No. 11—Nocogdoches	1,410.00	18,860.00	4,622.57	24,892.57		24,892.57	16,249.14	5,520.25	464.51	2,658.67
No. 12—Chillicothe	600.00	5,210.00	3,276.46	9,086.46		9,086.46	7,375.03	1,561.54	119.50	30.39
No. 14—Sonora	1,819.77	13,955.00	13,890.88	29,665.65		29,665.65	20,008.88	7,416.00	1,912.54	328.23
No. 15—Weslaco (Lower Rio Grande		15,511.65	5,859.32	21,370.97		21,370.97	15,764.75	3,169.19	1,569.77	867.26
No. 16.—Iowa Park, (Wichita Valley)		8,910.00	1,893.66	10,803.66		10,803.66	8,811.78	1,068.19	706.41	217.28
No. 19—Winter Haven	150.00	12,625.00	5,391.61	18,166.61		18,166.61	14,078.75	3,496.69	557.19	33.98
No. 20—Stephenville	1,690.00	15,629.87		17,319.87		17,319.87	6,842.44	2,352.33	2,921.18	5,203.92
Amarillo Soil Conservation	2,939.92		2,123.44	5,063.36		5,063.36	4,161.81	321.16	580.39	
Total Substations	$ 41,771.56	$ 214,739.95	$ 104,471.28	$ 360,982.79	$ 500.00	$ 361,482.79	$ 230,402.34	$ 87,640.50	$ 27,048.42	$ 16,391.53
Total Research and General (Exh. B)	$ 241,341.17	$ 383,526.76	$ 139,930.51	$ 764,798.44	$ 6,017.84	$ 770,816.28	$ 553,554.12	$ 139,911.32	$ 57,325.76	$ 20,025.08

Consisting of:

Buildings and Other Improvements	$ 18,698.44
Land	1,326.64
Total	$ 20,025.08
Add Equipment	57,325.76
Total Investment in Plant (Exh. E)	$ 77,350.84

SCHEDULE B-2—Continued

Statement of Current Expenditures

For the Year Ended August 31, 1941

ANALYSIS BY SOURCES OF FUNDS AND EXPENSE CLASSES

	DISTRIBUTION BY DIVISIONS		Total	DISTRIBUTION BY EXPENSE CLASSES			
	Main Station	Sub-Stations		Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements
RESEARCH AND GENERAL EXPENDITURES							
Current General Funds							
Federal Funds							
Hatch Fund	$ 13,726.36	$ 1,195.00	$ 14,921.36	$ 13,521.61	$ 701.79	$ 697.96	
Adams Fund	14,244.16	600.00	14,844.16	14,806.60	37.56		
Purnell Fund	58,219.55	2,077.50	60,297.05	53,696.56	5,225.64	1,316.05	$ 58.80
Bankhead-Jones Fund	113,379.54	37,899.06	151,278.60	123,052.29	17,442.72	10,307.57	476.02
Total Federal Funds	$ 199,569.61	$ 41,771.56	$ 241,341.17	$ 205,077.06	$ 23,407.71	$ 12,321.58	$ 534.82
State Appropriations	$ 168,786.81	$ 214,739.95	$ 383,526.76	$ 282,853.05	$ 60,886.19	$ 27,501.91	$ 12,285.61
Sales Funds	35,459.23	104,471.28	139,930.51	62,082.78	53,871.79	16,771.29	* 7,204.65
Total Current General Funds	$ 403,815.65	$ 360,982.79	$ 764,798.44	$ 550,012.89	$ 138,165.69	$ 56,594.78	$ 20,025.08
Current Restricted Funds (Sch. B 3)	5,517.84	500.00	6,017.84	3,541.23	1,745.63	730.98	
Total Research and General Expenditures	$ 409,333.49	$ 361,482.79	$ 770,816.28	$ 553,554.12	$ 139,911.32	$ 57,325.76	$ 20,025.08

Includes $1,326.64 for purchase of land.

SCHEDULE B-2a

Statement of Federal Hatch Fund

For the State Fiscal Year Ended August 31, 1941

Balance, September 1, 1940	$ 1,390.28	
Received from United States Treasurer	15,000.00	
Balance, September 1, 1940, plus additions		$ 16,390.28
Less Expenditures:		
Personal Services	$ 13,521.61	
Supplies and Materials	16.85	
Communication Service	85.89	
Travel Expenses	582.46	
Equipment	697.96	
Buildings and Land	16.59	
Total Expenditures		$ 14,921.36
Balance, August 31, 1941		$ 1,468.92

NOTE: Income and Expenditures are included in Schedule B–1 and B–2.

SCHEDULE B-2b

Statement of Federal Adams Fund

For the State Fiscal Year Ended August 31, 1941

Balance, September 1, 1940	$ 1,139.18	
Received from United States Treasurer	15,000.00	
Balance, September 1, 1940, plus additions		$ 16,139.18
Less Expenditures:		
Personal Services	$ 14,806.60	
Supplies and Materials	35.55	
Communication Service	2.01	
Total Expenditures		$ 14,844.16
Balance, August 31, 1941		$ 1,295.02

NOTE: Income and Expenditures are included in Schedule B–1 and B–2.

SCHEDULE B-2c

Statement of Federal Purnell Fund

For the State Fiscal Year Ended August 31, 1941

Balance, September 1, 1940	$ 5,846.18	
Received from United States Treasurer	60,000.00	
Balance, September 1, 1940, plus additions		$ 65,846.18
Less Expenditures:		
Personal Services	53,696.56	
Supplies and Materials	2,519.83	
Communication Service	356.61	
Travel Expenses	1,334.01	
Transportation of Things	118.00	
Heat, Light, Water and Power	68.82	
Contingent Expenses	13.85	
Equipment	2,038.52	
Buildings and Land	150.85	
Total Expenditures		$ 60,297.05
Balance, August 31, 1941		$ 5,549.13

NOTE: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-2d

Statement of Federal Bankhead-Jones Fund

For the State Fiscal Year Ended August 31, 1941

Balance, September 1, 1940	$ 14,271.12	
Received from United States Treasurer	149,364.76	
Balance, September 1, 1940, plus additions		$ 163,635.88
Less Expenditures:		
Personal Services	$ 123,052.29	
Supplies and Materials	10,610.97	
Communication Service	204.91	
Travel Expenses	5,239.28	
Transportation of Things	73.78	
Heat, Light, Water and Power	140.25	
Contingent Expenses	22.02	
Equipment	10,928.98	
Buildings and Land	1,006.12	
Total Expenditures		$ 151,278.60
Balance, August 31, 1941		$ 12,357.28

NOTE: Income and Expenditures are included in Schedule B-1 and B-2.

SCHEDULE B-3

Statement of Current Restricted Funds

For the Year Ended August 31, 1941

	Balance Sept. 1, 1940	INCOME: Gifts (Sch. B-1)	Total Balance and Additions	EXPENDITURES: Salaries and Wages	Other Operating Expense	Equipment	Buildings and Other Improvements	Total	Balance Aug. 31, 1941 (Exh. A; B)
FOR RESEARCH AND GENERAL PURPOSES:									
Texas Gulf Sulphur Fund	$ 1,730.38	$ 1,049.25	$ 2,779.63	$ 1,281.51	$ 794.43	$ 179.05		$ 2,254.99	$ 524.64
Freeport Sulphur Fund	487.04	1,500.00	1,987.04	430.98	629.08	533.03		1,593.09	393.95
Cotton and Fruit Insect Survey Fund	1,360.92		1,360.92	810.36	247.03			1,057.39	303.53
Cuprocide Fund	269.31		269.31	57.00	15.84	18.90		91.74	177.57
Dow Chemical Co. Fund		400.00	400.00	333.88				333.88	66.12
Niagara Fellowship Fund		600.00	600.00	350.00				350.00	250.00
American Potash Fund		500.00	500.00	277.50	59.25			336.75	163.25
Total Research and General	$ 3,847.65	$ 4,049.25	$ 7,896.90	$ 3,541.23	$ 1,745.63	$ 730.98		$ 6,017.84	$ 1,879.06

Add Equipment	$ 730.98
Total Investment in Plant (Exh. E)	$ 730.98

SCHEDULE B-4

Transactions of Revolving Funds

For the Year Ended August 31, 1941

	Credit Balance Sept. 1, 1940	CREDITS	Total	EXPENDITURES				Credit Balance Aug. 31, 1941
		Sales	Balance and Additions	Salaries and Wages	Other Operating Expense	Equipment	Total	(Exh. A)
FOR ORGANIZED RESEARCH								
Wool Scouring Plant	$ 424.66	$ 7,303.01	$ 7,727.67		$ 7,312.63	$ 5.00	$ 7,317.63	$ 410.04
Teacher Retirement System		17,998.70	17,998.70		17,998.70		17,998.70	
Cattle Feeding Revolving Fund	8,433.59	8,480.72	16,914.31			6,006.64	6,006.64	10,907.67
Total Organized Research	$ 8,858.25	$ 33,782.43	$ 42,640.68		$ 25,311.33	$ 6,011.64	$ 31,322.97	$ 11,317.71

EXHIBIT E

Summary Statement of Investment in Plant

At August 31, 1941

CARRYING VALUE OF PLANT, SEPTEMBER 1, 1940		$ 1,371,427.91
ADDITIONS DURING 1940-41:		
1. Expended from Plant Funds (None)		
2. Expended from Current General Funds (Sch. B-2)	$ 76,619.86	
3. Expended from Current Restricted Funds (Sch. B-3)	730.98	
Total Current General and Current Restricted Funds (Sch. B-2)	$ 77,350.84	
4. Expended from Revolving Funds (Sch. B-4)	6,011.64	
5. Expended from Feed Control Service Funds (Exh. F)	12,819.74	
6. Produced by Division or Substation	36,171.39	
7. Gifts	149.03	
8. Transfers from A. & M. College Inventory	842.77	
Total Additions		133,345.41
Carrying Value of Plant, September 1, 1940, plus additions		$ 1,504,773.32
DEDUCT:		
1. Sale of Equipment	$ 49,866.45	
2. Plant Assets worn out, discarded, etc.	12,110.43	
3. Transfers to A. & M. College Inventory	10,253.28	
Total Deductions		72,230.16
VALUE OF PLANT, August 31, 1941 (to Exh. A)		$ 1,432,543.16
Value of Plant, August 31, 1941, made up as follows:		
Land		$ 314,793.94
Buildings	$ 528,348.10	
Improvements Other Than Buildings	44,900.41	
Total Buildings and Other Improvements		573,248.51
Equipment		544,500.71
Total (to Exh. A)		$ 1,432,543.16

SCHEDULE E-1

Summary Statement of Inventory Valuation

At August 31, 1941

MAIN STATION:		
Administrative	$	38,394.38
Veterinary Science		35,298.72
Horticulture		40,652.98
Range Animal Husbandry		48,161.48
Entomology		18,012.98
Apiculture		18,350.94
Agronomy		27,066.27
Main Station Farm		49,561.85
Plant Pathology and Physiology		22,693.85
Soil Survey		3,380.47
Farm and Ranch Economics		7,133.98
Publications		51,347.72
Botany		3,631.74
Loco Weed Research		4,278.10
Chemistry		41,465.72
Photographic Laboratory		6,464.65
Agricultural Engineering		7,461.34
Rural Home Research		23,972.13
Feed Control Service		7,048.24
Total Main Station	$	454,317.54
SUBSTATIONS:		
No. 1—Beeville	$	45,137.37
No. 2—Tyler		45,569.13
No. 3—Angleton		76,652.61
Truck Crop Insect Investigations		3,619.97
No. 4—Beaumont		41,294.53
No. 5—Temple		88,270.56
No. 6—Denton		37,039.72
No. 7—Spur		62,691.49
No. 8—Lubbock		43,376.73
No. 9—Balmorhea		34,362.11
No. 10—College Station (Feeding and Breeding Station)		52,816.18
Division of Dairy Husbandry		41,040.64
Division of Swine Husbandry		35,809.00
Division of Poultry Husbandry		33,260.14
No. 11—Nacogdoches		55,641.38
No. 12—Chillicothe		48,835.40
No. 14—Sonora		164,495.37
No. 15—Weslaco (Lower Rio Grande)		122,585.17
No. 16—Iowa Park (Wichita Valley)		34,569.93
No. 19—Winter Haven		40,212.73
No. 20—Stephenville		30,292.32
Amarillo Soil Conservation		5,886.35
Total Substations	$	1,143,458.83
Total Inventory Valuation	$	1,597,776.37

Consisting of:		
Supplies and Crops Inventories	$	165,233.21
Invested in Plant		1,432,543.16
	$	1,597,776.37

EXHIBIT F

Transactions of the Feed Control Service

For the Year Ended August 31, 1941

INCOME			
Tag Sales		$ 181,409.24	
Total Income			$ 181,409.24
EXPENDITURES			
Salaries and Wages			
Administrative Salaries		$ 10,201.00	
Instruction and Research Salaries		21,219.00	
Clerical and Stenographic Salaries		14,249.34	
Wages		9,018.36	$ 54,687.70
Consumable Supplies			
Postage, Stationery and Office Supplies		$ 2,959.51	
Tags (Purchased)		17,494.89	
Scientific Supplies		596.73	
Feeding Supplies		1,382.29	
General Supplies		536.13	22,969.55
Expense			
Telegraph and Telephone		$ 383.04	
Travel		10,598.88	
Transportation of Things (Service)		54.19	
Publications		6,080.12	
Heat, Light, Power, Water and Gas		4,312.92	
Other Current Expenses (Including Chemical Analysis)		18,554.00	
Refunds		424.08	40,407.23
Repairs and Alterations			
Repairs to Buildings		$ 1,458.13	
Other Repairs		230.61	1,688.74
Total Salaries and Wages, plus Operating Expenses			$ 119,753.22
Equipment, Buildings and Other Improvements			
Main Office			
Furniture and Office Equipment		$ 677.17	
Books		11.56	
Total Main Office			$ 688.73
Other Divisions and Substations			
Division of Range Animal Husbandry			
Scientific Apparatus		$ 319.71	
Machinery and Tools		94.34	
Total Range Animal Husbandry		(414.05)	
Division of Publications			
Furniture and Office Equipment	$ 342.00		
Division of Botany			
Furniture and Office Equipment	$ 54.90		
Scientific Apparatus	140.00		
Total Botany	($ 194.90)		
Division of Chemistry			
Scientific Apparatus	523.15		
Division of Swine Husbandry			
Furniture and Office Equipment	$ 19.04		
Scientific Apparatus	1,273.20		
Books	9.53		
Buildings	1,971.19		
Total Swine Husbandry	($ 3,272.96)		

Division of Poultry Husbandry			
Scientific Apparatus	$ 426.05		
Livestock	24.00		
Buildings	5,995.47		
Improvements Other Than Buildings	199.08		
Total Poultry Husbandry	($ 6,644.60)		
Substation No. 20—Stephenville			
Improvements Other Than Buildings	739.35		
Total Other Divisions and Substation		$ 12,131.01	
Total Equipment, Buildings and Other Improvements			$ 12,819.74
Total Expenditures			$ 132,572.96
Surplus Transferred to A. & M. College			48,836.28
Total Expenditures and Surplus			$ 181,409.24